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# POTATO VALUE CHAIN ANALYSIS

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# FORWARD

*The goal of the Kenya Agricultural Value Chain Enterprises (USAID-KAVES) project is to increase the productivity and incomes of smallholders and other actors along targeted agriculture value chains, thereby enhancing food security and improving nutrition.*

*This report is one of a series of detailed analyses covering five value chains (maize, dairy, mango, potato, and French beans) conducted by USAID-KAVES to identify critical constraints/gaps and prioritize high-return program interventions that will contribute to the program's core objectives of:*

- *Increasing the competitiveness of selected agricultural value chains to mitigate food insecurity, improve nutrition, and increase the incomes of the rural poor;*
- *Fostering innovation and adaptive technologies and techniques that improve nutritional outcomes for rural households, sustainably reduce chronic under-nutrition, and increase household consumption of nutrition-dense foods; and*
- *Increasing the capacity of local organizations to sustainably undertake value chain work.*

*While drawing upon the extensive body of existing research on targeted Kenyan valued chains, USAID-KAVES analyses further builds on and updates those findings with primary data obtained through field surveys and interviews with value chain participants.*

# CONTENT

# EXECUTIVE SUMMARY

*Potato has a significant potential for addressing food insecurity in Kenya due to its high productivity per unit area and increasing demand.The average yield attained in 2012 (20.3 MT/ha) is higher than the global average (17 MT/Ha) and better than most potato growing countries. Our projections indicate that Kenya will maintain its current self-sufficiency and even increase surpluses. Consumption is expected to grow to 1.83 million in 2017 and 2.3 million in 2022, against the supply of 2.74 million MT in 2017 and 3.2 million MT in 2022. However, despite these high yields and growing surplus, national potato production and quality remains below its potential, largely due to limited use of clean seed, low or sub-optimal use of fertilizer and ineffective use of pesticides. As a result, wastage is high and high end food service consumers of frozen chips rely on imports.*

## INTRODUCTION AND METHODOLOGY

There are approximately 500,000 potato growers in the country, cultivating 143,000 ha, with an annual production of 2-3 million MT. The annual production of the crop is worth about KSh50 billion, and the industry has a strong multiplier effect, indirectly employing about 2.5 million people as market agents, transporters, processors, retailers, and exporters. Although many of the 22 target USAID-KAVES (hereafter "KAVES") counties have low potential for potato production, some target counties in the Rift Valley, eastern, and western regions are the leading sources of national supply. Producers sell their produce through local brokers, and to a smaller extent to wholesalers and specialized retailers. Among the KAVES target counties, only Meru has significant numbers of large-scale producers. Major challenges facing smallholder producers, especially those in the target counties, include low productivity due to low adoption of recommended agronomic practices, unfavourable weather, high disease prevalence, inefficient marketing chains, and poor infrastructure.

### Methodology

Building on the literature relating to the potato value chain in Kenya, a preliminary SWOT analysis was carried out in consultation with all members of the KAVES technical team, KAVES subcontractors and other potato experts to determine existing gaps in the literature and identify areas for further data collection and analysis. Based on this process, field surveys, focus group discussions, and key informant interviews were carried out to update existing information, validate secondary sources, and provide primary data specific to the KAVES target areas. Relevant data and analysis were reviewed and are discussed in this report, with alternative analyses and interpretations presented where appropriate. Data collected as part of the KAVES baseline survey of 1,800 producers was analyzed and pooled with a second panel survey selected from the first 16,000 producers receiving KAVES support. Finally, a smaller survey of wholesale traders was carried out to obtain specific information on cost and margins at different levels of the value chain. All growth estimates and projections are calculated using the compounded average growth rate (CAGR) formula.[1]

## SUMMARY OF KEY FINDINGS

### Consumption and Demand Analysis

National per capita potato consumption is expected to grow at an annual average rate of 5.2 percent for the next 10 years.[2] Based on current trends, we expect Kenyans to consume approximately 37 kg of potato per capita by 2017 and 41 kg by 2022. Nationally, Kenyans are projected to consume a total of 1.83 million MT in 2017 and 2.3 million MT in 2022. Urban demand, growing at 7 percent annually

[1] In calculating projections, if the absolute growth rate is greater than 50 percent, we divide it by three, and if greater than 20 percent, it is halved.

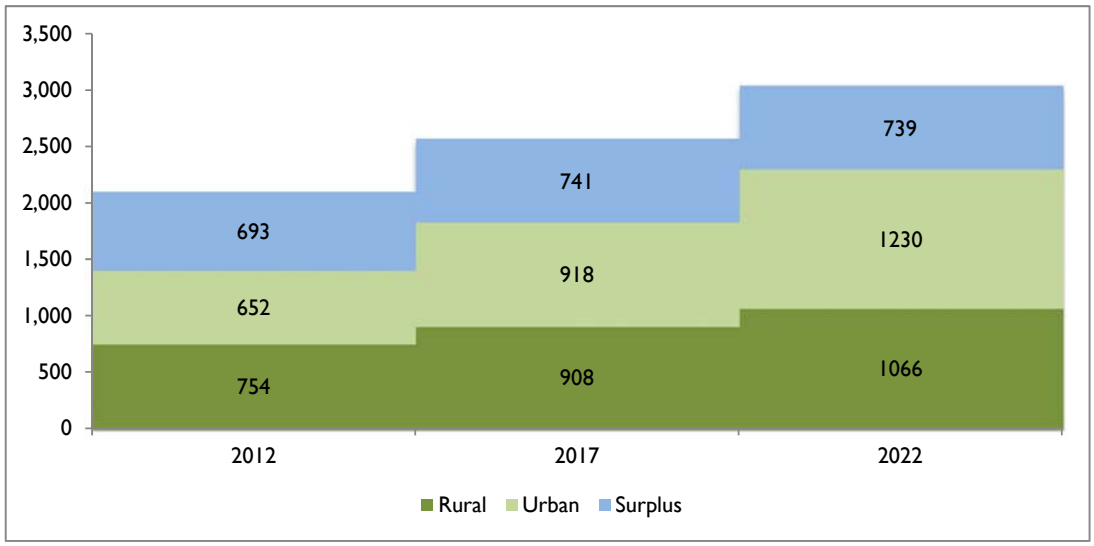
[2] CAGR rates are calculated in Table 3.

as a result of increased urban population and changing tastes, will drive most of the increases in consumption. Our projections indicate total urban consumption will surpass rural consumption by 2017, when urban households will account for about 50.3 percent of the total consumption, reaching 54 percent by 2022.

## Supply Analysis and Production Potential

Our projections indicate that Kenya will maintain its current self-sufficiency (except for special varieties needed for frozen chips) and even increase surpluses in potatoes over the next 10 years. Kenya is projected to produce 3.57 million MT in 2017 and 4.2 million MT in 2022. At current postharvest losses of 18 percent and seed retention of 10 percent of total produce, the expected availability from production is 2.57 million MT in 2017 and 3.04 million MT in 2022. Given projected consumption, total available surpluses will rise to 741,000 MT and 739,000 MT in 2017 and 2022, respectively. Surpluses currently move across the border to Uganda and neighboring countries although much of this trade is unrecorded.

**Estimated/projected demand and supply balance (in MT '000) between 2012 and 2022**




*Source: USAID-KAVES estimates*

## Potato Value Chain

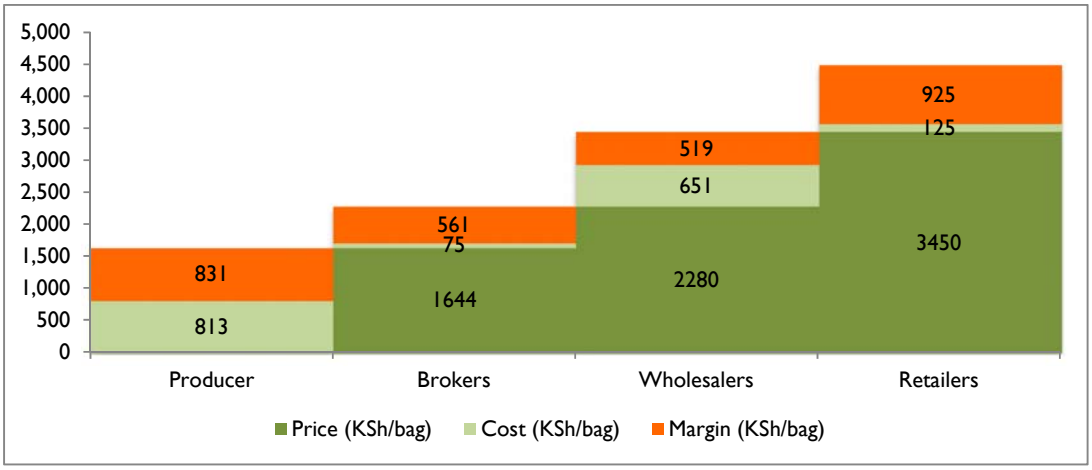
Approximately 96 percent of producers use uncertified seed: either potato retained from previous harvest, potato sourced from neighbors, or potato purchased from local markets. A majority of potato producers lack knowledge on seed selection. Moreover, latent infection of diseases such as bacterial wilt makes it difficult for producers to determine diseased potato selected for seed. Past and ongoing experiments have shown that simple seed production techniques, such as small seed plot and positive selection, result in substantial yield increases and reductions in disease prevalence.

Potato marketing channels are characterized by high level of price collusion among brokers within local production areas and at the national level. As discussed in Section 4, this limits ease of entry into trade and curtails information flow to farmers, thus lowering their bargaining power. Given the existing market structure, there is need for organizing growers in producer groups that can exert pressure on the current inefficient systems that inhibit change towards a more quality driven industry. Food service buyers who depend upon high quality potatoes for chips products reported that they buy mostly imported frozen chips.

## Margins Analysis

The analysis in this report shows that, at current costs and prices, producers earn the highest margins on their potatoes, at 51 percent, which are twice those of brokers (25 percent), and more than three times of wholesalers (15 percent). Although wholesaling seems to generate lower margins, given the opaque buying and selling practices prevalent in the markets, we believe that potato traders earn higher "hidden" margins from potato weight and baggage manipulation. Traders generally estimate that a bag contains 7 to 8 tins, which yields almost zero margin, whereas market studies consistently find nine to 10 tins in most bags (CIP, 2005, KAVES 2014). At KSh23 per kg, this could earn traders between KSh345 and KSh1,035 per extended bag although tariffs (formal and informal), wastage and dehydration losses are undoubtedly factors driving the lack of transparency and standards relating to weights.

**Potato Value & Margins Distribution along the Value Chain**




*Source: USAID-KAVES Estimates from Baseline Survey, 2013 and Markets RRA, 2014*

Despite the high margin, the magnitude and duration of investment make the producer's income the second lowest among value chain actors. Potato producers earn an equivalent of KSh5,194 (US$61) per month, or KSh20,775 (US$244) per crop cycle. In comparison, over the same period, a broker could earn approx. KSh337,000 (US$3,960) and a wholesaler could earn KSh415,200 (US$4,885).

**Estimated Earnings from Potato Enterprises per Crop Cycle**

| Actors | Gross margin (KSh per bag) | Volumes | Months of operation | Income |
|---|---|---|---|---|
| Producers | 831 | 41 bags per acre (25 bags on average plot – 0.6 acre) | 4 | KSh20,775 (US$244) |
| Brokers | 561 | 40 bag lorries, 5 lorries per month | 3 | KSh337,000 (US$3,960) |
| Wholesalers | 519 | 40-60 bags lorry, 4 trips per month | 4 | KSh415,200 (US$4,885) |
| Retailers | 925 | 5 bags per month | 4 | KSh18,500 (US$218) |

*Source: USAID-KAVES estimates*

## Enabling Environment

**Supporting Organizations & Institutional Actors:** Kenya's institutions, especially producer associations and public institutions, are not adequately developed to provide effective support to the potato value chain. Public regulatory institutions are inadequately staffed and funded. Their ability to regulate and enforce marketing and quality standards is limited. With so many powerful brokers along

the value chain, formal market organization and contract enforcement is near impossible and hence marketing innovation remains depressed.

**Policy regime:** Enforcement of regulations remains weak due to lack of standards and appropriate institutionalization of the laws. Traders have largely disregarded the regulation on standard bag size and other marketing matters, with bag sizes getting as large as 260 kg during periods of oversupply. This is a result of uncoordinated adoption and enforcement across the country and a lack of harmonization with the preferences of key potato markets.

**Infrastructure:** Overall, the poor state of storage facilities and roads contributes to high production costs, low sales prices, and high postharvest losses. Since potatoes are bulky, transportation on poor roads exerts substantial costs and discourages private transporters from venturing into certain areas.

## UPGRADING INTERVENTIONS

Potato has a significant potential for addressing food insecurity in Kenya due to its high productivity per unit area and strong and a growing market demand. However, under current conditions, the net return to smallholder growers is low and interventions should be focused on reducing the cost of production. Based on the information and analyses provided above, the table below presents three components for a KAVES intervention strategy to upgrade the performance of smallholders in the potato industry. The three components are supported by nine specific strategic interventions and 22 objectives that will increase on-farm productivity, streamline potato aggregation, and improve market systems for fresh and processed potato products. Interventions have been selected that will contribute directly to the goals and objectives of the KAVES project and are highly scalable through private sector partnerships, with varying levels of public sector support. The interventions all rely heavily on the mass adoption of new technologies, supported with specialist training and extension; new sources of investment and credit to unlock value chain constraints; and engagement of private sector partners for market development and sustainability

| Recommended intervention | Specific upgrading objectives | Challenges | Outcomes |
|---|---|---|---|
| **Strategic intervention 1: Increase productivity** | | | |
| **1. Improve farmers access to high quality extension services** | 1. Farmers organized into producer and marketing groups<br>2. Trainers trained in potato agronomy and marketing<br>3. New technologies adopted | • Low capacity of county government extension services<br>• Limited capacity of buyers and suppliers to provide technical support | • Higher farm yields, productivity and income<br>• Trained extension workers in public and private sectors |
| **2. Increase range and availability of alternative varieties** | 4. Partnerships formed between distributors and groups with seed importers<br>5. New varieties demonstrated and adopted | • Inadequate supply of basic seed<br>• Inconsistent quality of seed<br>• Few suppliers | • Higher yields<br>• More local production of suitable potatoes for processing<br>• Longer production seasons |
| **3. Increase use of clean seed** | 6. Growers adopt small seed plot techniques and positive seed selection<br>7. Number of seed multiplication merchants increased<br>8. Use of diffused light stores scaled up | • Shortage of foundation seed<br>• Few certified seed suppliers<br>• Cost of seed stores | • Higher yields<br>• Less crop failure<br>• Less wastage |

| | | | |
|---|---|---|---|
| **4. Optimize use of organic and inorganic fertilizers** | 9. Fertilizer application techniques including foliar feeds demonstrated and adopted<br>10. Number of bio-fertilizer suppliers increased<br>11. Fertilizer available in smaller packages | • Perceived high cost of fertilizer<br>• Few rural suppliers of specialist inputs | • Increased yields<br>• Reduced cost of production<br>• Increased gross margins |
| **5. Train farmers on potato IPM techniques** | 12. Biological pesticides demonstrated and adopted<br>13. Availability of approved products increased in rural areas | • Lack of availability of specialized inputs<br>• Few trainers available | • Higher quality potatoes<br>• Less wastage<br>• Safer products<br>• Reduced pesticide costs |
| **Strategic intervention II: Reduce post-harvest losses** | | | |
| **6. Improve post-harvest handling and storage systems** | 14. Low cost on-farm storage facilities demonstrated and adopted<br>15. New collection centers established | • Cost of materials<br>• Shortage of trainers<br>• No premium for higher quality | • Increased marketable yield and incomes<br>• Less wastage<br>• Extended marketing period |
| **7. Introduce quality standards** | 16. More trainers available on grades and standards<br>17. Standards adopted by growers and buyers | • Inefficient transport and wholesale systems<br>• No price incentives for higher quality | • More reliable markets for farmers<br>• Less wastage |
| **Strategic intervention III: Raise levels of aggregation and processing for greater market access** | | | |
| **8. Carry out detailed market survey** | 18. Accurate market information available<br>19. Farmers growing varieties for specific markets | • No institutional capacity for market analysis<br>• Few reliable sources historical data | • Better understanding of market operations<br>• Identification of apparent market inefficiencies<br>• Disaggregation of demand for fresh and processed potato products<br>• Potential for import substitution assessed |
| **9. Promote collective marketing** | 20. Groups obtain new contracts and marketing agreements<br>21. Farmers access new markets<br>22. Greater aggregation of product to obtain commercial loads | • Low business capacity of farmer groups<br>• Inefficient wholesale systems | • Increased sales and higher returns<br>• Farmers have more bargaining power |

# 1. INTRODUCTION AND BACKGROUND

## 1.1 INTRODUCTION

Ware potato[3] is the second most important food crop after maize in Kenya. The potato has a high protein to carbohydrates ratio and can provide the recommended daily allowance of Vitamin C. For these reasons, and others, the potato is considered strategic in reducing hunger and malnutrition (Abong *et al*., 2010). The annual production of the crop is worth about KSh50 billion, and the industry has a strong multiplier effect, indirectly employing about 2.5 million people as marketing agents, transporters, processors, vendors, retailers, and exporters (Potato Value Chain Report, 2012).

**Justification for Potatoes as a USAID-KAVES Targeted Value Chain**

- Annual production of the crop is worth KSh50billion, and industry directly and indirectly employs 2.5 million people.
- Fits well with the greater food security focus on nutritious and versatile staple foods not susceptible to international commodity market fluctuations.
- The potato produces more food per unit area and time than wheat, rice or maize, and is adaptable to a wide variety of farming systems and agro-ecological zones.
- The crop has a short and highly flexible production cycle (ready for harvest within 100 days of planting) and fits well with double-cropping and intercropping systems. It can be grown as an off-season crop.
- It is shielded from international shocks and thus good for ensuring food security.
- A great source of employment, with strong multiplier effect (five times the farm value).

There is increasing demand for potatoes in urban centers due to changes in consumption habits. Approximately 65 percent of the potato supplied to urban centers is processed into chips in fast food restaurants and hotels. In addition, processing of crisps has become a major commercial activity in urban centers given the high and growing demand. Statistics related to demand for potatoes is limited; however, three quarters of urban households are believed to consume potatoes regularly, on average 5 kg per adult per month.

The current total potato production is estimated at 2.915 million MT annually. Meru, Nyandarua, Bungoma, Nakuru, and Elgeyo Marakwet counties account for 85 percent of total production. More than 90 percent of farmers produce potatoes both for commercial and home consumption, but producers in the leading production zones mentioned above grow potatoes mainly for cash, selling over 60 percent of their produce (Nganga et al., 2003, cited by Muthoni, Shimelis & Melis, 2013).

Producers average 20.3 MT/ha, compared to the global average of 17 MT/ha. The potential is however much higher, but hampered by a number of factors, including inadequate quality planting material, poor agronomic practices, and prevalence of pest and diseases (Proceedings of Potato Round Table Meeting, 2012).

## 1.2 METHODOLOGY

Since many studies in the past have analyzed various aspects of the potato value chain, a preliminary SWOT analysis was conducted in order to determine existing gaps and identify areas for further data collection and analysis.

**Table 1: KAVES SWOT Analysis for Potato Production and Marketing**

[3] Solanum tuberosum L. Also known as ware potato. Throughout the report, the term 'potatoes' will be used to refer to Irish potatoes.

| Strengths | Weaknesses | Opportunities | Threats |
|---|---|---|---|
| • A key pillar of national food security and nutrition<br>• Wide acceptance as a source of food/nutrition<br>• Produces more food per unit area/time than alternatives<br>• Short/highly flexible production cycle<br>• Fits well in enterprise diversification & integrated value chains strategies<br>• Ready market | • A cartel-like market structure, conduct, and performance<br>• Inadequate standards in quality, weights/measures & pricing<br>• High postharvest losses<br>• Ineffective legal/regulatory framework<br>• Poor roads | • Increased production with new seed systems<br>• Processing opportunities as demand for processed products increases<br>• Possible utilization in non-food processing as raw material for production of soaps as well as other industrial starch<br>• Improved incomes through increased productivity and stable yields | • Drought and unreliable rainfall patterns<br>• High input costs<br>• Declining farm sizes<br>• Diseases/Pests<br>• Market distortions & price volatility |

*Source: USAID-KAVES, focus group discussions and key informant interviews (June 2013)*

All relevant studies and data were reviewed and are discussed in this study, in some cases with alternative analyses carried out and interpretations made. These are referenced throughout the study and all sources are listed in Annex I. Primary validation data was collected by subcontractor FCI through a series of focus group discussions with producers, traders, and processors in selected target counties. Data collected as part of the KAVES baseline survey of 1,800 producers was analyzed and pooled with a second panel survey of producers selected from the first 16,000 KAVES producers receiving support. Finally, a smaller survey of traders was carried out to obtain specific information on margins at different levels of aggregation.

# 2. CONSUMPTION AND DEMAND ANALYSIS

**This section examines the demand for potatoes in Kenya over the next 10 years. We build consumption and demand scenarios to evaluate the future of the potato industry in Kenya, including how changing food preferences will affect the national outlook for the industry. We use population statistics, urbanization rates, and per capita consumption trends to project Kenya's potato needs into 2022.**

Research on consumption of potato and potato products in Kenya is limited and, where available, the focus tends to focus on major urban centers, particularly Nairobi. Estimations and projections of national potato supply and demand are therefore based on best guesses, with some predicting surplus while others predict deficit. Most consumption calculations are based on the total annual potato production, not actual consumption data. Our analysis reviewed existing data to compute rough estimates of consumption levels.

## 2.1 DOMESTIC CONSUMERS

Potatoes make up an important component of the household food basket in urban areas in terms of per capita consumption. It is the leading staple food in most production areas of the central and eastern regions. Domestic consumers consist of households in urban areas and rural town centers, as well as institutions (hotels, restaurants, schools, hospitals, and others) that purchase potatoes for daily consumption. In rural homes, especially within the producing areas, potatoes are consumed daily for both lunch and dinner. Potatoes are used in stews and mashes, which form the staple foods for most people in these areas. Potatoes are mixed with meats and vegetables, such as carrots and cabbage, and made into stews that are eaten with ugali, chapatti, or rice. They are also used in traditional dishes mashed with maize, beans, peas, or other pulses and green vegetables. This mode of consuming potatoes is duplicated in urban homes of families whose origins are from potato growing areas.

At the commercial level, potatoes are mainly consumed as chips served in restaurants and takeaway facilities in Nairobi and other major towns in Kenya. The white varieties, such as Nyayo and Tana, are the most popular potatoes for chips, although some takeaway facilities prefer the red varieties, which they claim take less oil and give a higher volume of chips than the white varieties.

## 2.2 NATIONAL DEMAND ESTIMATION

Since nearly all potato production in Kenya is used locally (imports and exports are negligible), estimates of national consumption are derived from total production and population. The increasing demand for potatoes is linked to changes in consumption habits. This is mainly in urban centers, where chips have become an increasingly popular part of the diet over the past decade. Crisps processing has also become a major form of value addition for potatoes.

Estimates of per capita consumption of potatoes in Kenya vary widely. Apart from households, restaurants, hotels, and canteens are major potato consumers. Consumption patterns of potatoes fall between the categories of starchy staple food (inferior goods) and fresh vegetable (luxury goods). To precisely estimate consumption levels for each market segments is impossible. However, this section reviews secondary data and computes rough estimates of consumption levels. For ease of analysis, only two broad consumption segments, urban and rural households, are identified.

### 2.2.1 Overview of Existing Research

Kenya is believed to consume more potatoes per capita than many countries where potato is a major food crop (Nderitu, 2010). In 2010, Nderitu estimated the average national consumption of potatoes at 28 kg per person per year. This estimate appears lower than the national availability (calculated from

total supply and population projections in this report) of 47 kg and 54 kg per person in 2009 and 2010, respectively. Abong *et al.* (2010) found three-quarters of urban households consumed potatoes regularly, averaging 5 kg per adult per month, which translates to 60 kg per person per year.

Tegemeo Institute's study of urban food demand is the only available empirical evidence of household potato consumption. The study found that urban households consume about 60 kg of (ware and sweet) potatoes per person in 2009, with higher consumption at higher incomes (Table 2) (Kamau *et al.*, 2011). From FAOSTAT Kenya Food Balance Sheets (2003-2009), we estimate that ware potatoes constitute 75 percent of the total. This implies that urban households consumed 45 kg of ware potatoes per person that year based on Tegemeo (2008). Since earlier Tegemeo panel surveys did not cover rural potato consumption, this report uses absolute per capita supply to compute comparable numbers for 2003 and estimate the growth rate in potato consumption per capita.

Kenya produced 1.84 million MT of potatoes (about 1.22 million MT ware and 0.62 million MT sweet potatoes) in 2003 (FAOSTAT, Accessed December 2013). For a population of 33.8 million people that year, and further assuming 10 percent was retained as seed and another 10 percent lost, we estimate

**Table 2: Annual Per Capita Consumption , kilograms, of Potatoes in Nairobi 2003, 2009, and 2012**

| Food item | Year | By Income Quintile | | | | | Average |
|---|---|---|---|---|---|---|---|
| | | Lowest | 2 | 3 | 4 | Highest | |
| Potatoes (ware/sweet) | 2003 | n/a | n/a | n/a | n/a | n/a | 54 |
| | 2009 | 34 | 50 | 52 | 67 | 96 | 60 |
| | CAGR | n/a | n/a | n/a | n/a | n/a | 1.63% |
| | 2012 (est.) | 36 | 53 | 55 | 71 | 102 | 64 |

*Source: Adapted from Kamau et al. (2011)*

that each Kenyan consumed approximately 44 kg of potatoes on average, with 31 kg of this being ware. This national average however masks the significant difference between average urban and rural per capita consumption. From our own estimations, the per capita consumption in urban areas is about 1.3 times the national average. Taking this into account, our estimate of the average per capita consumption of potatoes in urban areas is 54 kg; this translates to 41 kg of ware potatoes per capita. Compared to 2009, therefore, the average per capita consumption of potatoes in urban areas grew at about 1.63 percent per year over the period 2003-2009.

If the aforementioned growth trend was maintained, it implies that urban households consumed an average of 48 kg of ware potatoes per capita in 2012. Given the rapid rise in convenience foods such as chips and crisps, the report estimated that urban areas consume another 10-12 kg of potatoes per person in restaurants, hotels, and fast food kiosks, which household consumption data do not capture. **Using rural/urban population and consumption differences, the national annual consumption per capita is estimated at 31 kg in 2003, 35 kg in 2009, and 38 kg in 2012.** On average therefore the 60 kg of potatoes consumed per person in urban areas in 2009 translates to about 22 kg per person in rural areas.

Per capita consumption of potatoes shows a strong correlation with income levels and production status. In Nairobi, for example, the households in the highest income category consumed about three times the amount of potatoes consumed per person in households in the lowest income group. There is a progressive increase in the amount of potato consumed as average household incomes increase. While the middle-income group consumed 50 percent more potatoes per person than the lowest income group, their per capita consumption was only 54 percent that of households in the highest income group (Kamau *et al.*, 2011). Urbanization and income growth will therefore remain key drivers of potato consumption going forward.

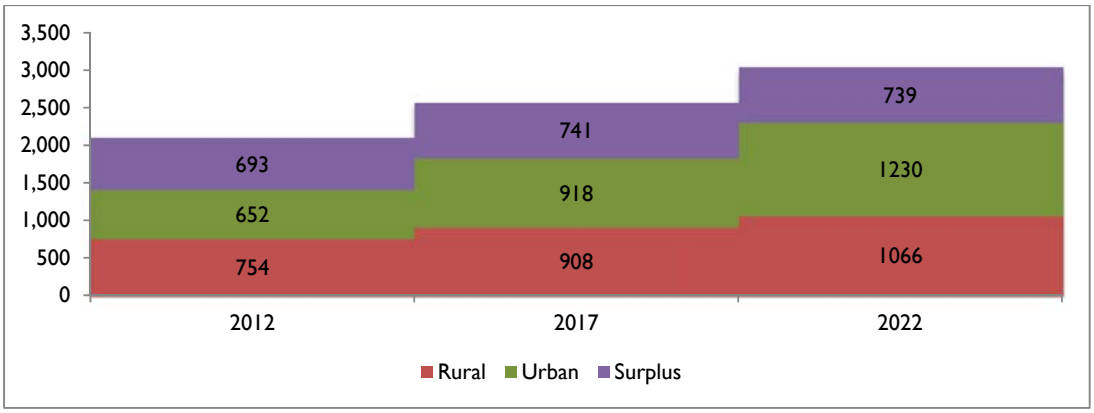
### 2.2.2 Estimation of Per Capita Consumption

Without credible rural/urban consumption data, this report applies the above analysis and various parameters and assumptions to compute projections of per capita consumption for the next 10 years

(Table 3)[4]. With increasing urbanization, we expect a continued rise in potato demand in line with growth of per capita income and urban population. Urban demand is projected to grow at an average annual rate of 7 percent over the next 10 years, while rural demand is expected to grow at 3.6 percent. Urban demand in 2012 is estimated at 651,648 MT, with annual per capita consumption of 64 kg (with consumption in rural areas of 24 kg). The urban per capita consumption is projected to increase to 71 kg in 2017 and 77 kg in 2022, which will require 917,811 MT and 1,230,249 MT of potatoes, respectively.

**As presented in Table 3, the national average annual per capita consumption in 2012 was 33 kg. Overall, the national per capita potato consumption is expected to grow at an annual average rate of 5.2 percent for the next 10 years.** Our projections indicate total urban consumption will surpass rural consumption by 2017, when urban households will account for about 50.3 percent of the total 1,826,205 MT to be consumed. By 2022, urban areas will consume 54 percent of the 2,296,717 MT projected as total consumption. Figure 1 summarizes the balance of demand and supply over the next 10 years.

**Figure 1: Estimated & Projected Potato Consumption (Thousands MT), 2012-2022**




*Source: USAID-KAVES calculations*

[4] The computation assumes the following: 1) urban per capita consumption will grow at 1.9 percent per annum; 2) rural per capita consumption will grow at 1.4 percent per year; 3) population growth rate of 3.0 percent, with a higher growth rate in urban (4.2 percent) than rural areas (2.0 percent); 4) urban population will increase from 24 percent in 2012 to 27 percent in 2017 and 29 percent in 2022; and, 5) real GDP per capita growth rate of 1 percent.

**Table 3: Estimated and Projected Ware Potato Demand, 2009-2022**

| Consumption | 2009 | 2012 | 2017 | 2022 | CAGR (2012-2017) | CAGR (2012-2022) |
|---|---|---|---|---|---|---|
| Rural per capita (est.) | 22 | 24 | 25 | 27 | 1.4% | 1.4% |
| Urban per capita (est.) | 60 | 64 | 71 | 77 | 1.9% | 1.8% |
| Population ('000) | 37,920 | 42,184 | 48,920 | 55,349 | 3.01% | 2.75% |
| Share of urban population | 23% | 24% | 27% | 29% | 2.0% | 1.9% |
| Rural consumption (MT) | 642,358 | 754,005 | 908,394 | 1,066,467 | 3.8% | 3.5% |
| Urban consumption (MT) | 523,290 | 651,648 | 917,811 | 1,230,249 | 7.1% | 6.6% |
| Estimated national consumption (MT) | 1,165,649 | 1,405,653 | 1,826,205 | 2,296,717 | 5.4% | 5.0% |
| **Estimated per capita consumption (kg)** | **31** | **33** | **37** | **41** | **2.2%** | **2.2%** |
| Availability from production (MT) | 1,656,098 | 2,099,149 | 2,567,095 | 3,035,807 | 4.1% | 3.8% |
| Surplus/(Deficit) - MT | 490,449 | 693,496 | 740,891 | 739,091 | 1.3% | 0.6% |
| Production surplus/(deficit) % | 42.1% | 49.3% | 40.6% | 32.2% | -3.8% | -4.2% |
| Projected imports (MT) | 5,409 | 2,511 | 4,739 | 8,047 | 13.5% | 12.4% |
| Imports as % of consumption | 0.46% | 0.18% | 0.26% | 0.35% | 7.8% | 7.0% |
| Projected exports (MT) | 1,612 | 2,445 | 5,135 | 9,530 | 16.0% | 14.6% |
| Exports as % of domestic production | 0.10% | 0.12% | 0.20% | 0.31% | 11.4% | 10.4% |
| Available Surplus/(Deficit) (MT) | 494,246 | 693,562 | 740,495 | 737,607 | 1.3% | 0.6% |
| Export potential | 495,858 | 696,008 | 745,630 | 747,137 | 1.4% | 0.7% |
| Marketed production (65% 2009-12; 70% 2017-22) | 1,076,464 | 1,364,447 | 1,796,967 | 2,125,065 | | |
| Urban share of total consumption | 44.9% | 46.4% | 50.3% | 54.0% | | |

*Source: USAID-KAVES calculations*

## 2.3 CHARACTERISTICS AND REQUIREMENTS OF PRINCIPAL BUYERS

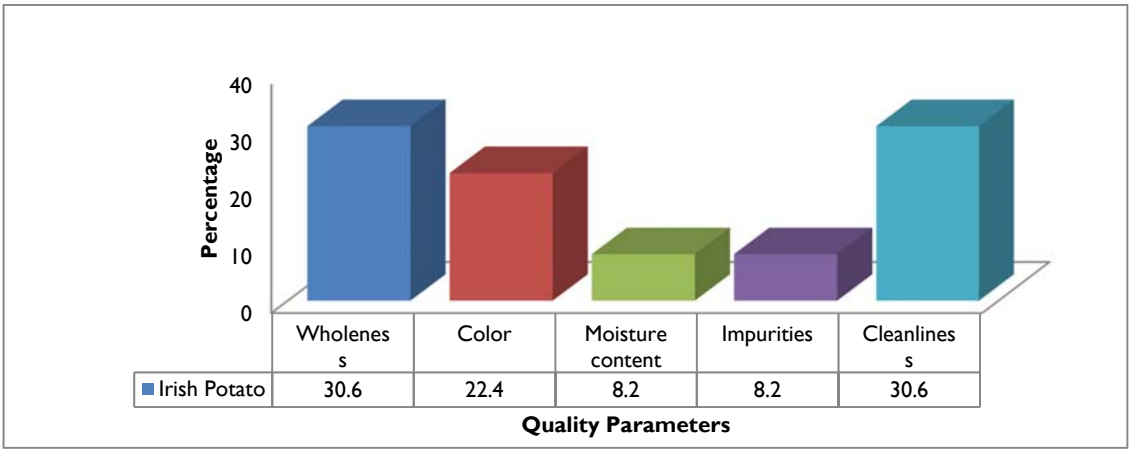
Various activities take place at the market place, including value addition and marketing:

- *Washing*: Mainly carried out on Dutch Robijn and Desiree varieties destined for leading supermarkets and other high-end retail outlets.
- *Sorting and grading*: Performed both by wholesalers and retailers, but is most commonly carried out by retailers. Wholesalers who supply potatoes to hotels, institutions, and supermarkets undertake sorting and grading. Retailers sort and grade their potatoes to charge different prices, because graded potatoes attract better prices and thus justify the additional labor.
- *Packaging*: At the wholesale markets, potatoes are sold in extended bags weighing 120 kg, 150 kg, and 180 kg. For the retail market, the extended bags are repackaged into nets and plastic paper bags. The size of pack depends on the target market but mostly the nets are 2, 3, or 5 kg.
- *Display*: Wholesalers display potatoes on the back of transport trucks. Retailers display their potatoes in 20 kg and 4 kg tins or spread on mats at retail market places or roadsides.
- *Breaking bulk:* At the wholesale level, a truck (7 ton with 40 bags) is considered a single consignment but wholesalers often sell individual bags. Others break the bags and sell in smaller quantities, e.g. half a bag or tins. Retailers break bulk even further by selling in tins of various sizes or much smaller units specified by value, mostly KSh10 or KSh20.
- *Pricing and promotion*: Prices are set daily depending on the supply. Market participants are able to anticipate daily supply and demand patterns based on experience and market intelligence from the field.

Traders and other buyers consider various quality parameters when buying potatoes. These include cleanliness, wholeness, injuries and damages, and moisture content (shriveling). The USAID-KAVES Value Chain Assessments (see Figure 2) found that 61 percent of formal buyers considered wholeness and cleanliness of potatoes the key quality indicator. This is expected because spoilt potatoes are easily observable, and dirt and soil residues can hide injuries and rotting. Approximately 22 percent of buyers considered the color of the tuber important because exposure to sunlight or water affects the physiology of tubers. Moisture was not thought to be a problem although reduced moisture was noted to lead to shriveling, thus reducing potato quality and appeal. Approximately 8.2 percent of respondents identified other impurities related to unscrupulous marketing practices including adding stones, soil, and other foreign matter to increase bag weights.

**Bagging requirements** (extended bags) is an important aspect of potato marketing. Although government regulations require potatoes to be packed in standard 110 kg bags, traders do not adhere to this rule. The most commonly used potato package is the sisal bag. Contrary to the rule, potato is packaged in extended bags ranging from 120 - 180 kg. Some local governments in Meru, for example, are enforcing standard weight bag to protect producers from exploitation by traders. However, since the Nairobi market requires an extended bag, traders transship potatoes to other locations (such as Nanyuki) where they are offloaded and then repackaged into extended bags.

**Figure 2: Quality Parameters Considered by Formal Buyers**




*Source: USAID Kenya Agricultural Value Chain Enterprises (KAVES), 2013*

## 2.4 SUMMARY OF FINDINGS

The national per capita potato consumption is expected to grow at an annual average rate of 5.2 percent for the next 10 years. Kenyans will consume an average of approximately 37 kg annually by 2017 and 41 kg by 2022. Kenyans are projected to consume a total of 1,826,205 MT in 2017 and 2,296,717 MT in 2022. Urban demand, growing at 7 percent annually as a result of increased urban population and changing tastes, will drive most of the increases in consumption. Our projections indicate total urban consumption will surpass rural consumption by 2017, when urban households will account for about 50.3 percent of the total consumption, and reach 54 percent by 2022.

The higher demand will likely need to be met with domestic production, due to the market preference and the short shelf life of fresh potatoes. It is doubtful, based upon the growth rates in Table 3, that Kenyans will increase potato consumption at rates sufficient to absorb the expected increase in production. Our projections in Section 4 indicate that Kenya will maintain self-sufficiency in potatoes and even increase surpluses, thereby presenting opportunities for value addition and exports. The processing and export potential stands at 745,630 MT in 2017 and 747,137 MT in 2022. We project exports to grow at an average 15.3 percent per annum to reach 9,530 MT in 2022 and imports at 13 percent per year to 8,047 by 2022.

# 3 SUPPLY ANALYSIS AND PRODUCTION POTENTIAL

**This section examines how much supply is likely to increase in the next five to 10 years, and whether this will be able to keep pace with demand. We build supply and production scenarios to evaluate the future of the potato industry, including key drivers, trade patterns and supply constraints to project Kenya's potato supply into 2022.**

The potato crop is grown mainly in cool, high altitude areas with well-distributed rainfall. The most suitable elevation is between 1,500 meters and 2,500 meters above sea level. The main growing areas are found in the central, eastern, and Rift Valley regions. The central region produces more than 53 percent, while eastern and Rift Valley regions produce a combined total of 44 percent. In the eastern region, the main growing region is in Meru in the areas around the slopes of Mount Kenya. In the central region nearly all the districts produce some potatoes, with Nyandarua, which lies along the Aberdare mountain range, being the largest and most diversified potato producing area. In the Rift Valley, potatoes are grown in the Mau Escarpment area in Dundori, Mau Narok, and Molo, and in the western highlands of Kericho, Bomet, Uasin Gishu, and Elgeyo Marakwet.

Most of the 22 target USAID-KAVES counties do not grow potatoes but those that do are among the leading production zones in the country, including Rift Valley, eastern, and western regions.

## 3.1 PRODUCTION TRENDS AND PROJECTIONS

An accurate analysis of potato supply and demand is undermined by inconsistencies in Kenyan production data. Different sources report widely disparate figures for potato acreage and output, thus making computation of yields and consumption near impossible. FAO (2013), for example, observes that the figures it uses are 20 percent higher than those reported by FAOSTAT for the years 2008–2010, and 36 percent lower than the total inputed by informed observers for the same period. These inconsistencies arise largely because there is no consensus on the actual size of an average bag of potatoes, namely whether it weighs the government mandated 110-kg, or is closer to the more commonly utilized 120 kg, 150 kg or 180 kg bags.[5] Whereas government official statistics assume all bags of potatoes sold are standard 110 kg, industry informed observers and other agencies use averages of actual bag sizes observed at markets. Any analysis of national potato supply and recommendations for intervention must take into account such inconsistencies in the reported data. The content of this report is no exception and any estimates or projections must be treated with caution.

From MOA official statistics, and assuming 110 kg bags, the area under potato production increased by 40 percent from 102,240 ha in 2007 to 143,325 ha in 2012, while production increased by 43 percent from 2.03 million tons to 2.91 million tons over the same period. This increase amounts to annual compound growth of 8.6 percent between 2010 and 2012 (Table 4).

**Table 4: Potato Area and Growth Rates, 2006-2012**

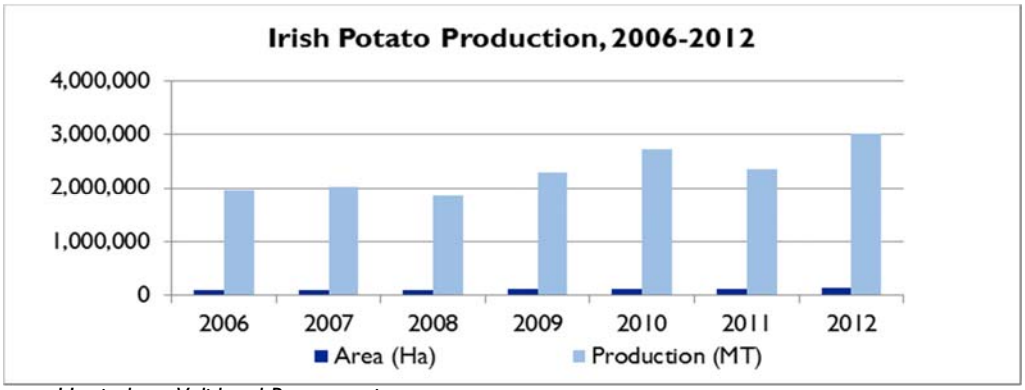
| Year/Growth | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | CAGR (2010-2012) | CAGR (2008-2012) |
|---|---|---|---|---|---|---|---|---|---|
| Area (ha) | 99,560 | 102,240 | 110,728 | 120,246 | 121,542 | 123,390 | 143,325 | 8.6% | 6.7% |

*Source: MOA & FAOSTAT*

[5] MOA estimates of acreage are based on an assumption that all farmers plant two crops per year. This is not always the case. Output figures are based on estimates of average yields per unit. Reported output therefore varies depending on who is reporting, the assumed bag size, and the method used.

Since yields have not increased substantially (growing 2.2 percent between 2007 and 2012), the expansion in area is solely responsible for increased potato production (Horticulture Validation Report, 2012). Further area expansion, however, is limited to growing sites above 1500 meters where existing planting materials is considered suitable for production.

**Figure 3: Cultivated Area (ha) and Production (MT) of Potato, 2006-2012**




*Source: Horticulture Validated Report, various*

Table 5 shows the distribution of potato production in 2012. Three USAID-KAVES target counties, Meru, Elgeyo-Marakwet and Bomet, account for about 25 percent of national production. Meru is the highest volume producer of the three, with 367,969 MT (13 percent of national production), followed by Elgeyo-Marakwet at 324,288 MT (11 percent) and Bomet at 42,155 MT (1 percent).

**Table 5: Production of Potatoes in Selected Counties, 2012**

| County | Production Area (ha) | Quantity (MT) | Yield (MT/ha) | Value (Million KSh) | Unit value (KSh per kg) |
|---|---|---|---|---|---|
| Nyandarua | 27,520 | 835,054 | 30.3 | 10,973 | 13.14 |
| Nakuru | 22,566 | 512,165 | 22.7 | 5,388 | 10.52 |
| Meru | 18,092 | 367,969 | 20.3 | 14,513 | 39.44* |
| Kiambu | 18,769 | 144,619 | 7.7 | 1,709 | 11.82 |
| Elgeyo-Marakwet | 20,992 | 324,288 | 15.4 | 4,319 | 13.32 |
| Bomet | 2,987 | 42,155 | 14.1 | 792 | 18.79 |
| Narok | 6,292 | 85,332 | 13.6 | 2,331 | 27.32* |
| Nyeri | 7,821 | 61,143 | 7.8 | 1,140 | 18.64 |
| National Total | 143,325 | 2,915,067 | 20.3 | 50,372 | 17.28 |

*Source: Horticulture Validated Report 2012*

** The unit values appear too high, either quantity is underestimated or the value is overestimated.*

## 3.2 KEY DRIVERS OF PRODUCTION

Unlike maize, potatoes have a short growth cycle, maturing in about 100 days. They can be easily integrated into existing farming systems, especially during short rain periods. Despite this, the potato sector tends to perform below its potential because of poor production technology, small and declining farm sizes, and poor crop management practices (e.g. poor rotation practices that results in low yields and high prevalence of pests and disease). National production remains below potential and fluctuates significantly due to limited use of clean seed, low application of fertilizers and other organic amendments, and low use of fungicides and other chemicals (Muthoni & Nyamongo, 2009). Varietal research is slow and restricted to the public sector, and supply of clean seed meets less than 4 percent of national demand. This section highlights some of the drivers of potato production, including a description of the production system, technology and productivity, and postharvest management.

### 3.2.1 Climate Conditions

Potato production is predominately rainfed in all regions of Kenya. Accordingly, potato-growing seasons are largely determined by rainfall patterns, with two distinct seasons between February-June and October-December.[6] Farmers usually plant two potato crops annually, in three-month intervals between harvests. Planting for the short rains is undertaken in October and November, for harvesting in January and February, and planting for the long rains is in March and April, for harvesting in July and August (Table 6). A few farmers, mostly in Meru, who have invested in small-scale irrigation that rely on gravity-fed lines tapped from streams are able to plant in January and February, for harvests in April and May, and again in August and September for November and December harvesting. With the minimal seasonal temperature variation, irrigated potatoes can be planted at any time, and importantly, harvesting coincides with lower market supplies and hence commands higher prices. In Meru, where such systems exist, potatoes are available most of the year.

**Table 6: General Potato Cropping Calendar, Meru, Kenya**

| Crop | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Short Rain | H | H | | | | | | | | P | P | |
| Long Rain | | | P | P | | | H | H | | | | |
| Irrigated | P | P | | | H | H | | P | P | | H | H |

*Calendar months January through December; P = Planting; H = Harvesting*
*Source: World Potato Atlas (Kenya)*

### 3.2.3 Potato Production Systems

**Potato production system in Kenya**

- Producers' varietal preferences are constantly shifting with time as once popular varieties are completely abandoned by growers.
- Potatoes are sold mainly at harvest without storing for future sale, which adds to seasonal gluts and shortages.
- Nearly all potato production takes place under rainfed conditions.
- On-farm seed storage takes place under rustic conditions and employs natural ventilation.
- There is a mismatch between the varieties that producers prefer and those multiplied in certified seed programs.

Potatoes are mostly grown in small-scale mixed farming systems consisting of maize, beans, potatoes, and cabbages. Because of its short and highly flexible vegetative cycle and its great adaptability to a wide variety of climates, the potato is a natural component of any crop rotation. It can be intercropped with many cash and food crops, and rotated with crops such as barley, maize, and wheat. Most potatoes in Kenya are grown as pure stands and a few producers intercrop potatoes with maize or beans. While most producers practice short crop rotations, due to small farm sizes, potatoes are grown without any rotation. The most common rotation sequences are potato-maize/beans-potato and potato-maize/bean/cabbage-potato (Muthoni et al.).

Over 90 percent of potato farmers produce it for both commercial and home consumption. Farmers in the leading production zones, such as Nyandarua, Meru, Bomet, Nakuru, Nyeri, and Elgeyo Marakwet, grow potatoes mainly for cash, selling over 60 percent of their produce (Nganga *et al.*, 2003, cited by Muthoni *et al.*). A survey in Nyandarua by CIP in 2005 found farmers sold 65 percent of their produce, retained 16 percent for home consumption, saved another 15 percent for seed, and wasted (or fed to animals) 4 percent.

In a survey of producers in three major potato-producing areas (Bomet, Molo, and Meru Central) in 2011 and 2012, Muthoni *et al.* found household average total farm sizes between 0.9 and 2.1 ha, with the majority of producers allocating about 25 percent of their farms to potatoes per crop season. These small plots are rarely planted with optimal plant populations. Potato seeding rates vary significantly across farms and regions. Extension services recommend 2 MT per hectare of potatoes,

[6] This brief is based on World Potato Atlas - CIP-Collaboration. Accessed January 2, 2014. https://research.cip.cgiar.org/confluence/display/wpa/Kenya.

but past research has found much lower seeding rates of 1.3 to 1.6 t/ha in most areas, with the higher rate of 2 t/ha mostly common in the Meru area (Durr and Lorenzl, 1980, cited in World Potato Atlas - Kenya). These variations in seeding rates greatly affect yields and output. Reasons why farmers prefer lower seeding rates are less understood.

More than 60 different potato varieties are maintained by KARI–Tigoni, including: Nyayo, Meru, Arka, Cangi (Shangi), Maritta, Desiree, Kerr's Pink, Dutch Robijn, Anett, Romano, Roslin Tana, B53, Kihoro, Kenya Furaha, and Kenya Baraka. Relatively few of these varieties are widely distributed. The dominance of certain varieties shifts with time, with producers abandoning a once popular and widely grown variety within a short period of time (FAO, 2013). The predominance of certain varieties also varies by region. The red-skinned Dutch Robijn is widely grown in Bomet while Molo producers prefer the white-skinned Shangi, and producers in Meru Central grow the red-skinned Asante. All producers in Bomet Central were found to grow the red-skinned Dutch Robijn, followed by the red-skinned Desiree (Muthoni et al.). In Meru, a majority of farmers planted the red-skinned Asante, followed by the white-skinned Tigoni. The white-skinned Shangi is most popular in Elburgon and Molo divisions, followed by Tigoni.

**The availability of markets and yield potential are the key determinants of variety preferences among producers.** A unique characteristic of Kenya's potato farmers is the degree they adopt and disadopt potato varieties. Farmers routinely change potato varieties, replacing old lines based on yields, susceptibility to disease, and market preferences. Nyayo (a developed variety), for example, was among the most widely cultivated varieties in Kenya in the 1990s but due to changing market preferences has almost disappeared from farms, replaced by Shangi (another farmers' variety) and Tigoni (an officially released variety). Over a span of five years, a majority of producers were found to have changed their favorite potato cultivar, with some areas completely abandoning certain varieties (Muthoni et al 2013). Given the pace of variety adoption, use, and change, it is critical to streamline the process by which varieties are approved by authorities and disseminated to producers.

Market studies found that over 90 percent of potatoes at Nairobi's Wakulima Market from Bomet are supplied to crisps processors, while the remainder goes to supermarkets and dedicated groceries in upmarket shopping centers (ECAPAPA, 2005; Kirumba, Kinyae, & Muchara, 2004). The Bomet potato is considered premium quality and therefore rarely sold in ordinary retail stores. This is partly because its yields are lower than other widely grown varieties. Muthoni et al. confirm that market access is the most important factor considered by Bomet farmers in deciding which potato cultivar to grow. In other areas the authors studied, farmers considered high yields the single most important factor, while those in Elburgon and Molo preferred early maturing varieties that allow for more crop cycles per year.

The local landrace Shangi has become very popular in these areas primarily because of its early maturity and high yield traits. The diversity of producer preferences documented above confirms the need for more research and development related to variety introduction and release. This will be something that will require the involvement of public and private institutions alike.

### 3.2.2 Productivity

Widespread inconsistencies in national potato statistics – both among Kenyan sources and between official government and FAO data (largely as a result of differences in recorded bag sizes as discussed above) have led to disagreements over the average potato yields in Kenya, with some sources, such as FAOSTAT, showing sharp declines from 9.7 t/ha in 2003 to 2.6 t/ha in 2009, while recent research suggests that actual productivity may be grossly underestimated (Gildemacher *et al.*, 2009; Obare *et al.*, 2010). Over the period 2007-2012, MOA statistics show that national average potato yields fluctuated between 16.8 t/ha in 2008 and 22.4 t/ha in 2010. **In 2012, national yields averaged 20.3 t/ha.**

At the 2012 level of productivity, Kenya's national potato yields are above the global average of 17 t/ha and well above the average for similar rainfed production systems (FAOSTAT, Accessed December 2013). Kenya's average yield was near par with Poland (20.5 t/ha) and higher than Russia and Ukraine's 13.4 t/ha (Table 7). In East Africa, Malawi produced 17.9 t/ha in 2012, Tanzania 8.5 t/ha, and Uganda 7.6 t/ha. However, while yields in Kenya are considered relatively high, they vary greatly across potato growing areas due to climate variation, incidence of pest and disease, and seed quality (discussed in Section 3.6).

On average, Kenya's national potato yields are already above the global average of 17 t/ha and far outstrip the average for similar rainfed production systems.

The findings from the USAID-KAVES Baseline Survey present possible opportunities for intervention to increase potato yields in target FTF counties. We compute each scenario in Table 7. It shows the yield gaps required increases to bridge the gaps, and the outcome of increasing yields by an average rate. USAID-KAVES could increase the average yields to either the world or Kenya average yields (for Meru, the target yield should be Nyandarua's). The average yield effort required across the three counties to reach the national average is 38 percent, ranging from 6 percent in Meru to 66 percent in Bomet. To reach the world average, yields would have to increase by 17 percent, from no change in Meru to 39 percent in Bomet. The mean level of effort required across the counties to attain the world or national yields is 27 percent.

Interventions to increase each county's average yields by 27 percent would increase yields to 16 t/ha, 20 t/ha, and 24 t/ha in Bomet, EMC and Meru, respectively. This would increase the 2012 output to 901,106 MT, which translates to approximately 166,694 MT more potatoes (equivalent to 6 percent increase in the 2012 national production). The USAID-KHCP supported demonstration sites have shown this level of increase is possible – with yields as high as 29 t/ha achieved (USAID-KHCP Snapshot, 2013). Furthermore, on-farm trials conducted in Kenya by Gildemacher *et al.* (2011) to assess whether producer-managed positive seed selection could improve yields have shown the technique improves the quality of seed potato and increases average yields by between 28 and 53 percent. It also reduced disease prevalence by 44 to 66 percent. On average, across the trials, the technique increased average yields by 34 percent, netting potato farmers an additional US$333 per hectare.

By itself, positive seed selection could increase yields by 28-53 percent and reduce disease incidence by 44-66 percent.

Since the Dutch Robijn or Desiree premium processing varieties, known for lower yields (≈12 t/ha), dominate production in Bomet, the average yields reported appear near the optimal levels, and thus will be the most difficult to increase. Interventions in Bomet could therefore hinge more on increasing the area under potatoes. Starting from a lower planted area, and together with problems associated with maize production identified in the USAID-KAVES Maize Value Chain Analysis Report 2014, the County offers great opportunities for area expansion and enterprise diversification. Developing the county's potato value chain to bring in more processors and high-end groceries market chains could greatly benefit the farmers.

**Table 7: Yield Increases Necessary for Targeted FTF Counties to Attain National and World Average Potato Yields**

| County | Average (2010-2012) Area (Ha.)* | 2012 Yield (MT/Ha)** | Yield Gap from World Average | Yield Gap from Kenya Average | Yield Increases Needed To Attain National Average | Yield Increases Needed Attain World Average | Projected Yields (MT/Ha)*** | 2012 Output (MT) | Projected Output (MT)**** |
|---|---|---|---|---|---|---|---|---|---|
| Bomet | 3,189 | 12.2 | -28% | -40% | 66% | 39% | 16 | 42,155 | 46,441 |
| Meru | 16,018 | 19.2 | 13% | -5% | 6% | 0% | 24 | 367,969 | 442,683 |
| Elgeyo Marakwet | 14,800 | 15.4 | -9% | -24% | 32% | 10% | 20 | 324,288 | 411,983 |
| Average | | 15.6 | -8% | -23% | 38% | 17% | 20 | 734,412 | 901,106 |
| *Kenya** | | *20.3* | | | | | | | |
| *Nyandarua** | | *30.3* | | | | | | | |
| *World* | | *17.0* | | | | | | | |
| *Average World Yields (2012):***** Netherlands: 45.2, Germany 44.8, South Africa: 35.1, Algeria: 30.4, Poland: 27.3, Malawi: 17.9, Russia: 13.4, Ukraine: 13.3, Tanzania: 8.5, Uganda: 7.1* | | | | | | | | | |

*Source: * HVR 2012; ** USAID-KAVES baseline survey (2013); *** Yields given 27 percent increase in % average yield; **** Based on 2012 area planted; ***** Estimates from FAOSTA*

### 3.2.4 Postharvest Handling and Storage Losses

Postharvest handling practices at the farm level include sorting, grading, weighing, and packaging. Sorting is the most common postharvest activity practiced. Since smallholders harvest mixed varieties and damaged (cut or rotten) tubers together, sorting is necessary to fetch better prices. Grading and packaging activities are done to meet bagging requirements (extended bags) and deal with the bulky nature of potatoes. The common form of grading done at farm level is picking out seed to be retained for new planting; everything else is sold, and in seasons of shortages, producers sell off even poor quality tubers.[7] Potatoes that are damaged during harvest are prepared for home consumption or fed to livestock.

This analysis finds that, in addition to poor seed quality, the established practice of early (premature) harvesting of potatoes for immediate sale makes postharvest handling of potatoes the most important driver of quality, prices, produce losses, and producer returns. Potato producers have different perceptions about postharvest losses – they tend to use most of the potatoes, including those rejected by traders. Our review of the literature and field interviews estimate potato losses at the farm-level at an average of about 8 percent, ranging from 5 percent to 20 percent, largely a result of rotting, greening, excessive moisture content, and pest and disease infestation. In addition, results of RRA surveys of wholesale traders indicate market losses average 7 percent (with 10 percent as the mode) from greening, injuries, small size, and spoilage. When another 3-5 percent is added to cater for losses at the retail level through greening, shrinkage, and rotting, the national average postharvest loss is approximately 18 percent. An additional 10 percent of potatoes produced are saved for seed. **By these calculations, only about 72 percent of potato produce may be available for consumption at any given harvest season**.

Unlike grains, potatoes have a short shelf life and must therefore be disposed of quickly or stored properly to avoid spoilage. On-farm storage is not a common practice and most marketed potatoes are typically sold shortly after harvest. Occasionally producers will dig pits lined with leaves to bury potatoes, which result in high losses during the rainy season due to high moisture levels. Where on-farm storage is practiced, like in Meru, producers have developed their own storage structures made of cemented or raised wooden floors, wooden walls, and corrugated iron roofs (GTZ, 1998). In the upper and cooler regions, producers store potato crop and seed outside the house covered with dry grass. Under these conditions potatoes can be kept for two to three months, due to the cold and windy weather.

At the commercial level, the storage of potatoes is generally for short periods prior to processing for restaurants and hotels. Some producers store potatoes in bags in their houses or in multipurpose stores but only a few use improved storage methods. Cold storage for potatoes is limited across growing and marketing regions, and the use of storage technologies, such as sprout suppressants, to prolong the shelf life of tubers is uncommon. On-farm seed storage is done in basic stores with natural ventilation. Seed tubers are stored in heaps in the house or outside in pits to enhance sprouting. Only a few producers use improved Diffused Light Storage (DLS) technology, and only KARI-Tigoni and ADC-Molo uses cold stores for seed (FAO, 2013). Breaking seed dormancy remains a major challenge for smallholder producers who plant two crops a year, and this is among the key drivers of farmers decisions to abandon varieties with long dormancy periods.

## 3.3 PRICE SEASONALITY TRENDS

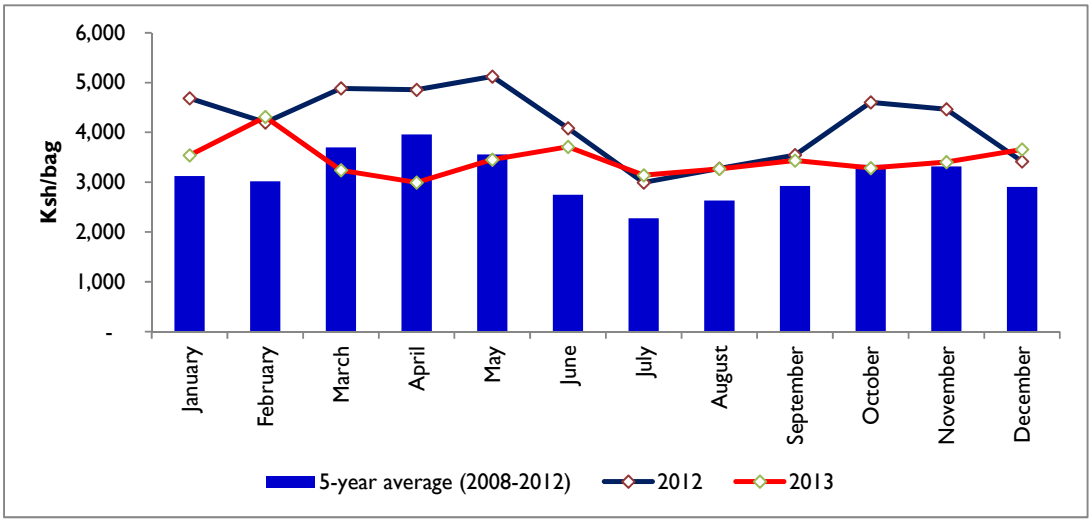
The fresh potato market is largely insulated from international price shocks because only a small fraction of total production enters global markets, mainly as processed products (FAO, 2013). Potato prices in Kenya are therefore determined by local demand and supply conditions, not by fluctuations

[7] Farmers sort potatoes informally into four grades. Grade 1 consists of potatoes for sale. Grade 2 potatoes are egg-sized, and are kept as seed and excess quantities sold. Grade 3 is sorted for home consumption and some may also be sold as seed, while Grade 4 includes all the small potatoes consumed at home or fed to livestock (GTZ, 1998).

in international markets. These demand and supply factors include production cycles and levels, climatic conditions, and urban consumption trends. Prices vary with the season, region and skin color. Price variation also occurs by region based on market characteristics, such as distance to markets and road conditions (Wang'ombe, 2006). Farm gate prices are lowest during harvesting time, especially when it rains in areas with poor roads.

Figure 7 shows the monthly variation in Nairobi wholesale prices. Prices in 2012 were more than 20 percent higher than the previous five-year average. Price trends from June 2012 to March 2013 show a general increase in prices, with May 2012 having recorded the highest average national price (over KSh5,000) and July the lowest (KSh2,860) for a 110 kg bag (MOA Food Security Report, 2013). All trade sources reported that potato demand is increasing continuously for both fresh sales and for processing.

**Figure 7: Potato Nominal Wholesale Price Trends in Nairobi**




*Source: MOA & USAID-KAVES RRA 2014*

Nominal prices have increased 9.4 percent per year in the past five years and 10.8 percent annually in the past three years (Table 8). These price increases, however, are products of inflation. Real prices decreased over the same period under review by a much faster rate of 2.9 percent per year over the last three years.

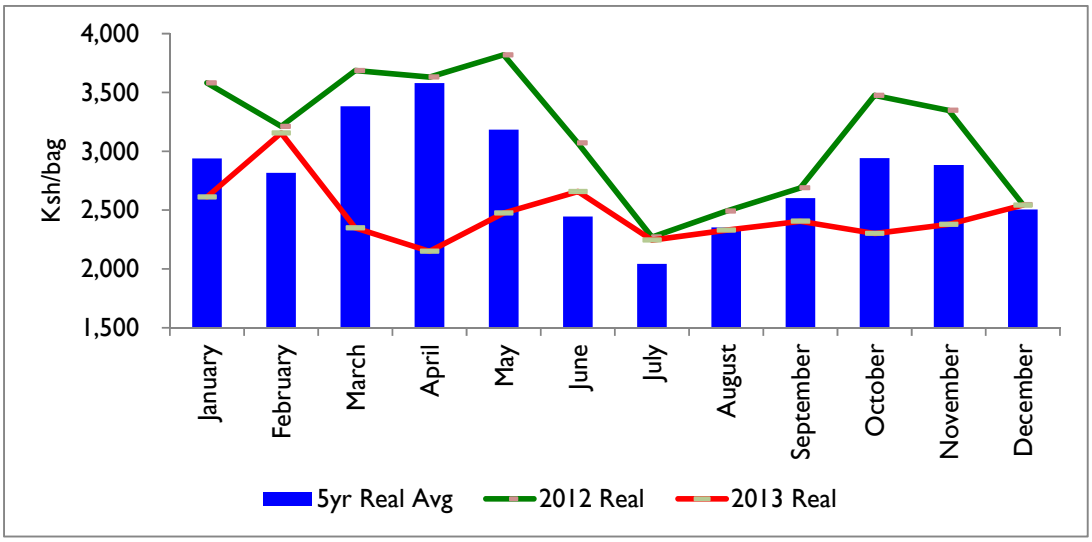
**Table 8: Growth Rate of Wholesale Potato Prices, 2009-2013**

| Growth Rate (CAGR) | Nominal Prices | | Real Prices | |
|---|---|---|---|---|
| | Monthly | Annually | Monthly | Annually |
| 5-Year (2009-2013) | 0.8% | 9.4% | -0.1% | -0.7% |
| 3-Year (2011-2013) | 0.9% | 10.8% | -0.2% | -2.9% |

*Source: USAID-KAVES estimates*

Figure 6 presents the monthly trend for real prices from 2008 to 2013. It shows the real wholesale price of potatoes in 2013 was lower than the historical trend in most months, and lower or equal to 2012 prices.

Figure 6: Potato Real Price Trends in Nairobi




*Source: USAID-KAVES calculations from Figure 5*

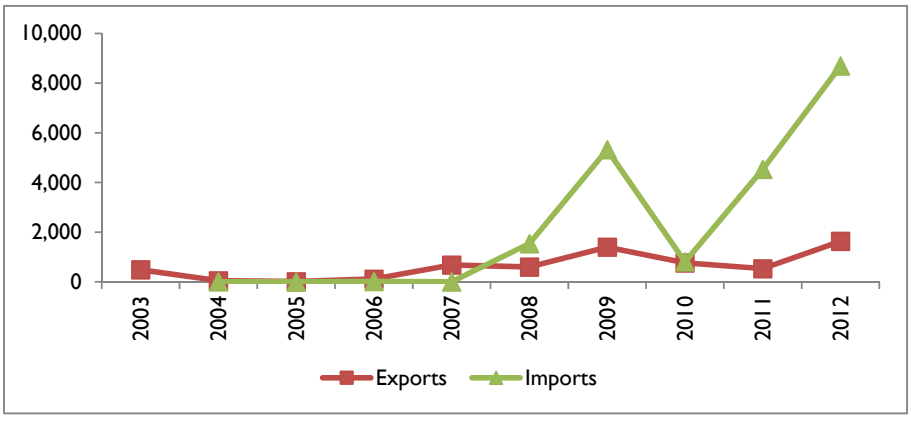
## 3.4 TRADE PATTERNS

Available cross border trade data is considered suspect and is known to exclude a large volume of existing trade due to its informality. Past studies by USAID funded projects and the Uganda Bureau of Statistics (2012), among others, have shown that in some cases, informal (unrecorded) agricultural commodity trade in eastern and southern Africa accounts for as much as 60 percent of total trade.

In 2012, Kenya imported about 8,691 tons of fresh and frozen potato products, about 0.3 percent of the total domestic availability. This demand is not expected to grow significantly. Approximately 1,634 tons of potato was exported in 2012 (ITC Trade Map, 2014). This amounted to less than 0.1 percent of the total potatoes produced in the country and is projected to remain flat in 2017 and 2022.

Because of unique tastes and preferences for fresh potatoes, low competition from global markets, and the bulkiness of potatoes, the Kenyan potato sector is highly competitive against imports.

Figure 7: Potato Trade (MT), 2003-2012




*Source: ITC Trade Map & FAOSTAT*

## 3.5 SUPPLY PROJECTIONS

Applying trend analysis to the data contained in the previous sections, we have made estimates of Kenya's national supply five and 10 years into the future. We use yields, potato losses, retained seed, and trade data to estimate future supply. The 2012 production year is treated as the base year and our key assumptions include constant yields, output growth at the 2010-2012 CAGR of 3.4 percent, and normal climatic conditions. Total domestic production is projected to increase to 3.56 million MT in 2017 and 4.21 million MT in 2022 (Table 9).

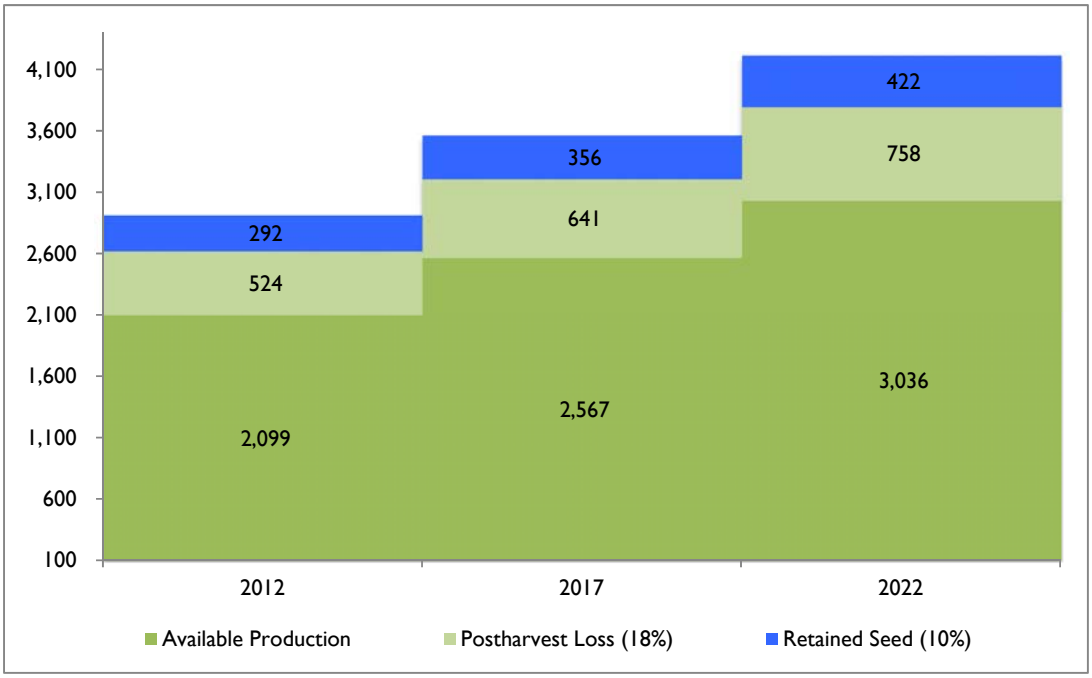
**Table 9: National Potato Supply Parameters & Projections**

| Population & Per Capita Consumption | |
|---|---|
| Population in 2012 (million) | 42 |
| Population Growth Rate | 2.7% |
| National Per Capita Consumption in 2012 (kg) | 33 |
| **Production Area** | |
| Total National Arable Land ('000 ha.) | 5,500 |
| Potato Area in 2012 (ha.) | 143,325 |
| Potato Area as Percent of Total (2012) | 3% |
| CAGR (2010-2012) | 8.6% |
| CAGR (2008-2012) | 6.7% |
| **Production (MT)** | |
| 2012 | 2,915,067 |
| 2010 | 2,725,936 |
| 2007 | 2,035,400 |
| 2003 | 1,223,531 |
| CAGR (2010-2012) | 3.4% |
| CAGR (2007-2012) | 7.4% |
| CAGR (2003-2012) | 10.1% |
| **Yield (MT/Ha.)** | |
| Kenya Average Yield 2012 | 20.3 |
| CAGR (2010-2012) | -4.9% |
| CAGR (2008-2012) | 3.9% |
| Estimated World Average Yield | 17.0 |
| **Imports (MT)** | |
| 2012 | 2,511 |
| 2010 | 930 |
| 2008 | 1,577 |
| 2003 | 10 |
| CAGR (2003-2012) | 12% |
| **Exports (MT)** | |
| 2012 | 2,445 |
| 2010 | 855 |
| 2008 | 769 |
| 2003 | 627 |
| CAGR (2010-2012) | 33.5% |
| CAGR (2003-2012) | 16% |
| **Projections** | |
| **2017 – Production (MT)*** | **3,564,899** |
| 2017 – Imports (MT) ** | 4,739 |
| 2017 – Exports (MT) ** | 5,135 |
| **2022 – Production (MT)*** | **4,215,794** |
| 2022 – Imports (MT) ** | 8,047 |
| 2022 – Exports (MT) ** | 9,530 |

*Source: USAID-KAVES estimates. Notes: * Assumes annual growth of 3.4%; ** Assumes annual growth of 11.2% for imports and 13.2% for exports.*

With national average postharvest losses at 18 percent and retained seed at 10 percent, **supply availability from domestic production is projected at 2.57 million MT and 3.04 million MT in 2017 and 2022**, respectively. Figure 8 summarizes the supply projections from Table 9. **Measured against the findings of the demand analysis in this report, we expect that Kenya will more than meet its national potato demand in 2017 and 2022 through domestic production, with substantial surplus available for export.**

**Figure 8: Estimated and Projected Supply of Potatoes (thousand MT), 2012-2022**




*Source: USAID-KAVES estimates*

Potato imports are negligible compared with national production and therefore unlikely to significantly influence domestic consumption and farm-gate prices. Imports are projected to grow at a compounded average rate of 11 percent per year to 4,739 tons in 2017 and 8,047 tons in 2022. Exports will grow at an average rate of 13.2 percent annually, reaching 5,135 tons in 2017 and 9,530 tons in 2022 (Table 9). Despite having the largest production volumes outside South Africa, Kenya has not significantly penetrated regional export markets to date. To do so the private sector must substantially organize itself to meet volume and quality requirements from potential markets within COMESA and the EAC.

Kenya could increase potato self-sufficiency without increasing the area under cultivation by increasing yields and/or by reducing postharvest losses. We build those scenarios in Table 10 using 2012 production and consumption levels. Had postharvest losses been reduced by 30 percent in 2012 (to 12 percent under Scenario 1), 157,414 MT more domestic potatoes would have been available on the market, equivalent to a 19 percent increase in available surpluses. Alternatively, had average yields been 20 percent higher in 2012 (at 24 t/ha), an additional 419,830 MT would have been available, as shown under Scenario 2. This scenario alone would increase the available surplus by 60 percent. The combination of 20 percent higher yields and 30 percent lower postharvest losses would have increased the national supply by 29 percent, adding 608,726 MT to domestic supplies – a 87 percent increase in surpluses (with yield increases accounting for 69 percent). Since reductions in postharvest losses at the marketing level require interventions at the loosely organized informal markets, most of the gains envisaged in this report mostly derive from farmers. The 30 percent target therefore appears ambitious as it implies a reduction in farm-level postharvest losses to 5.5 percent. Increasingly unpredictable climatic fluctuations and disease outbreaks could affect these projections. The potential effect of climate change is discussed in the next section.

Table 10: Scenarios with 2012 National Potato Production (MT)

| Scenarios | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| | Production | Postharvest Loss + Retained Seed | Available Supply [A+B] | National Demand (from Table 3) | Surplus (Deficit) [C-D] | Factor |
| **Baseline/Actual:** Yield 20.3 t/ha; 18% PHL; 10% retained seed | 2,915,067 | (815,918) | 2,099,149 | 1,396,505 | 702,644 | |
| **Scenario 1:** Baseline with 30% reduction in PHL (to 12%) | 2,915,067 | (658,504) | 2,256,563 | 1,396,505 | 860,057 | 1.22 |
| **Scenario 2:** Baseline with 20% increase in yield | 3,498,080 | (979,101) | 2,518,979 | 1,396,505 | 1,122,474 | 1.60 |
| **Scenario 3:** Baseline with 30% reduction in losses (to 12%) AND 20% increase in yield | 3,498,080 | (790,205) | 2,707,875 | 1,396,505 | 1,311,370 | 1.87 |

*Source: USAID-KAVES estimates*

The analysis illustrates how small increases in yields or reductions in losses can have a significant impact on domestic production and supply, as well as returns for producers (higher sales combined with lower unit production costs) and traders (through reduced losses).

## 3.6 SUPPLY CONSTRAINTS AND THREATS

This section highlights the constraints and threats the potato sector must contend with to remain competitive and meet the national consumption needs in the near future. The potato sector is plagued by numerous problems including lack of clean seed, lack of proper pest and disease management, unpredictable rainfall, disorganized marketing systems, and poor enforcement of packaging regulations (Riungu, 2011, GIZ-PSDA Kenya, 2011, Muthoni et. al.)

***Potato Production Constraints:***

- Inadequate supply of quality seed
- Variable climatic factors
- High postharvest losses and harvesting of premature crop
- Minimal value addition (grading, cleaning of tubers)
- High cost of farm inputs
- Inadequate production information and technology
- Lack of affordable credit or suitable financing system
- High occurrence of diseases and pests

### 3.6.1 Productivity Constraints

Despite the relatively high productivity levels of potato producers in Kenya, a number of critical constraints still plague the sector. Applying improved agronomic practices, positive seed selection, conservation, and enhanced pest and disease management has tremendous potential to increase the competitiveness of the sector and expand surpluses such that Kenya can become a major exporter to the region.

***Disease management gap***: On one recent survey, over 90 percent of sampled producers cited diseases as the main potato production constraint (Muthoni et al, 2013). Since producers rely on retained seed, existing viruses are passed on to subsequent crops. Bacterial wilt and potato late blight are both widely observed throughout the sector. Gaps in the management of potato diseases remain one of the critical challenges to production. Muthoni *et al.* found over 15 percent of producers managed diseases by uprooting and throwing the wilting plants and their tubers into a pit dug outside the field

and then burning them. They also remove the soil (from where the wilting plant has been uprooted) and put it into the pit. Subsequently they apply two handfuls of ash in the place where the plant has been uprooted and mix it well with the soil.[8]

Use of ***low yielding seed varieties:*** Most of the varieties currently in use were released in the 1990s and have either degenerated or lost resistance to major diseases such as the potato late blight (Schulte-Geldermann, 2013). Available potato varieties also do not possess characteristics useful to small-scale producers, such as variation in maturation periods and dormancy that could allow flexible planning, resistance to drought, and greater yield stability.

**Constraints on the adoption of high yield seed varieties:**

- Lack of demand for seed due to an inadequate supply of information on advantages of new varieties. Producer awareness is an important element in adoption of new varieties;
- Potato inherently has a low multiplication rate (about 10 seed tubers per plant) and potato seed is bulky and perishable;
- Lack of investment in breeding and multiplication programs due to land grabs and consequent loss of key land for seed multiplication and rising fuel prices;
- Current practice of variety release mechanisms is focused primarily on high-input agriculture, which is unsuitable for the mostly low-input production systems; and
- Lack of harmonization and lengthy evaluation and selection processes slows down the release of improved germplasm.

Between 2000 and 2011, Kenya's public potato breeding program only released seven new potato varieties. Adoption rates of these and other improved varieties has been low, planted on less than 10 percent of total potato area, due to limited availability of seed tubers, high cost, and the farmer preference for ready available farmer developed varieties (FAO, 2013). Existing potato varieties are restricted to minimum altitudes of 1,500 meters above sea level. The CIP is currently evaluating varieties that are tolerant to drought and heat at altitudes ranging from 1,000 to 2,500 meters above sea level, and have preselected some promising breeding lines to enter into National Variety Registration processes. These are expected to be available for farmers in approximately one and half years (Pers. Comm. between USAID-KAVES and CIP, 2013).

Most potatoes in Kenya are consumed fresh (which included potatoes processed at restaurants as chips), but greater urbanization is rapidly changing consumption patterns in favour of easy-to-prepare foods such as frozen chips (French fries). There is high potential for the potato processing industry, and market access is improving with increased demand for both fresh-cut and frozen potato chips. Suitable varieties that combine processing quality with drought and heat characteristics mentioned above are currently in short supply. In recent years, KARI has developed new higher yielding potato varieties (Table 11), some with attractive disease resistance and processing quality features, but low adoption by farmers has hampered their potential value (Hortfresh Journal, 2012; FAO, 2013). The certified seeds are not only more expensive but also require farmers to rely on a small, unpredictable seed potato market for their planting materials. Moreover, a majority of farmers still prefer farmer-multiplied seed potato that have most of the aforementioned desirable characteristics and easy to exchange informally. KARI, for example, has promoted the Kenya Mpya variety since 2010 as a replacement for the currently most popular farmer-multiplied potato variety (Shangi), but its adoption rate remains dismal.

**Table 11: Characteristics of Potato Varieties Recently Released in Kenya, 2006–2010**

[8] KARI is currently promoting this disease management strategy because ashes and lime are known to suppress the bacteria by raising the soil pH. In addition, ashes have the added advantage of containing nutrients such as potassium and phosphorus. There is no rule on the exact amounts to be applied; one handful of lime or two handfuls of ashes is commonly used as a maximum dose per plant. After harvesting, a majority of producers bury rotten tubers in manmade ditches.

| Variety | Skin color | Shape | Maturity Period[1] | Yield[2] | Year of release | Traits |
|---|---|---|---|---|---|---|
| Kenya Faulu[3] | Red | Long | Late | High | 2006 | |
| Kenya Karibu | Red | Oval | Late | High | 2006 | |
| Kenya Mavuno | White | Round | Late | High | 2006 | |
| Kenya Sifa | Red | Oval | Late | V. High | 2006 | |
| Kenya Mpya | White | Round | Med. early | High | 2010 | Virus/blight tolerant; short dormancy; great for chips/mashing |
| Purple Gold | Purple | Round | Late | Medium | 2010 | Virus/blight tolerant; excellent crisping quality; greening resistant; good storability |
| Ken. Sherekea | White | Round | Late | High | 2010 | Virus and blight tolerant; multiuse quality |

*[1]Maturity period: early (<90 days), medium-early (91–100 days), medium (101–110), medium-late (111–120 days), late (121–130 days), very late (>131 days).*
*[2]Yields: low (<20 t/ha), medium (21–30 t/ha), high (31–40 t/ha) and very high (>40 t/ha).*
*[3]No longer in production due to poor conservation strategies resulting in a loss for the potato program*
*Source: KARI-Tigoni Annual Reports, cited in FAO (2013)*

**Farm Size:** Reliance on small plots (less than 2 acres) for potato production limits the use of certain agronomic and management practices, such as crop rotation, seed multiplication, and mechanical harvesting. The result tends to be heavy application of pesticides and high crop loss. Counties with larger than average land sizes, like Uasin Gishu and Elgeyo Marakwet, provide better opportunities for expanding production area and increasing productivity through crop rotation and seed multiplication. Where average land sizes are small, more diversified, intensive, and integrated production systems tend to provide more value to producers.

**Climate Variability and Change:** With a near complete reliance on rain fed production, rainfall patterns greatly affect potato yields across Kenya. While existing models do not suggest a serious threat to Kenyan producers from climate change (Waithaka et al., 2013), it is important to consider potential implications of such shifts if they do occur. There are likely to be two principle effects from climate change: first, there is likely to be a geographic shift in potato production from increasing rainfall in areas that are currently arid or semi-arid, which would allow potatoes to thrive in areas otherwise too arid to grow potato. Second, average temperature is projected to increase making traditional highland production too warm for existing, heat intolerant, varieties. The greatest threat from climate change is the likelihood that growing seasons in some producing areas will shorten due to depressed and unpredictable rainfall. In the short term, interventions targeting water harvesting and small-scale irrigation schemes can mitigate these effects. In the longer term, introduction of heat tolerant varieties is likely to be essential.

### 3.6.2 Poor Connectivity to Markets

Poor transportation and marketing infrastructure is a common feature in most potato producing areas across Kenya. Due to the limited market access, especially during the rainy season, producers sometimes lose their entire harvest and are consistently challenged by vehicle and/or road maintenance problems. The bulky nature of potatoes exacerbates this problem, with most rural access roads unable to carry full-load trucks (average truckload is 40 bags), particularly during the rainy season, when producers must cart (normally donkey carts and bicycles) their produce to central collection points along all-weather roads or market centers for packaging and sale. After hauling bulky produce to the collection points, few producers want to return home with their produce, reducing their bargaining vis-à-vis buyers. Without proper on-farm storage or preservation technology, transportation bottlenecks and the long time-to-market expose producers to extraordinarily high risks of loss and quality deterioration[9].

[9] There were no available studies on the extent to which quality affects farm gate prices.

## 3.7 SUMMARY OF FINDINGS

If the national average postharvest losses remain at 18 percent and retained seed at 10 percent, supply availability from domestic production is projected to be 2.57 million MT and 3.04 million MT in 2017 and 2022, respectively. Measured against the findings of the demand analysis in this report, Kenya will more than meet its national potato needs in 2017 and 2022 through domestic production, with substantial surplus available for export.

The average yield attained in 2012 (20.3 MT/Ha) is higher than the global average (17 MT/Ha) and better than most potato growing countries in the region. Despite these impressive yields, national potato production is well below its potential, largely due to limited use of clean seed, sub-optimal use of inputs, poor agronomic practices, and unreliable weather.

In order to address the aforementioned factors limiting productivity, there is the need to promote own seed production by farmers through the following: small seed plot and positive selection, access to farm inputs for farmers, adoption of recommended agronomic practices with regard to land preparation, appropriate seeding rate, and pest and disease management by improving farmers access to quality and effective extension services, and promoting use of low cost irrigation.

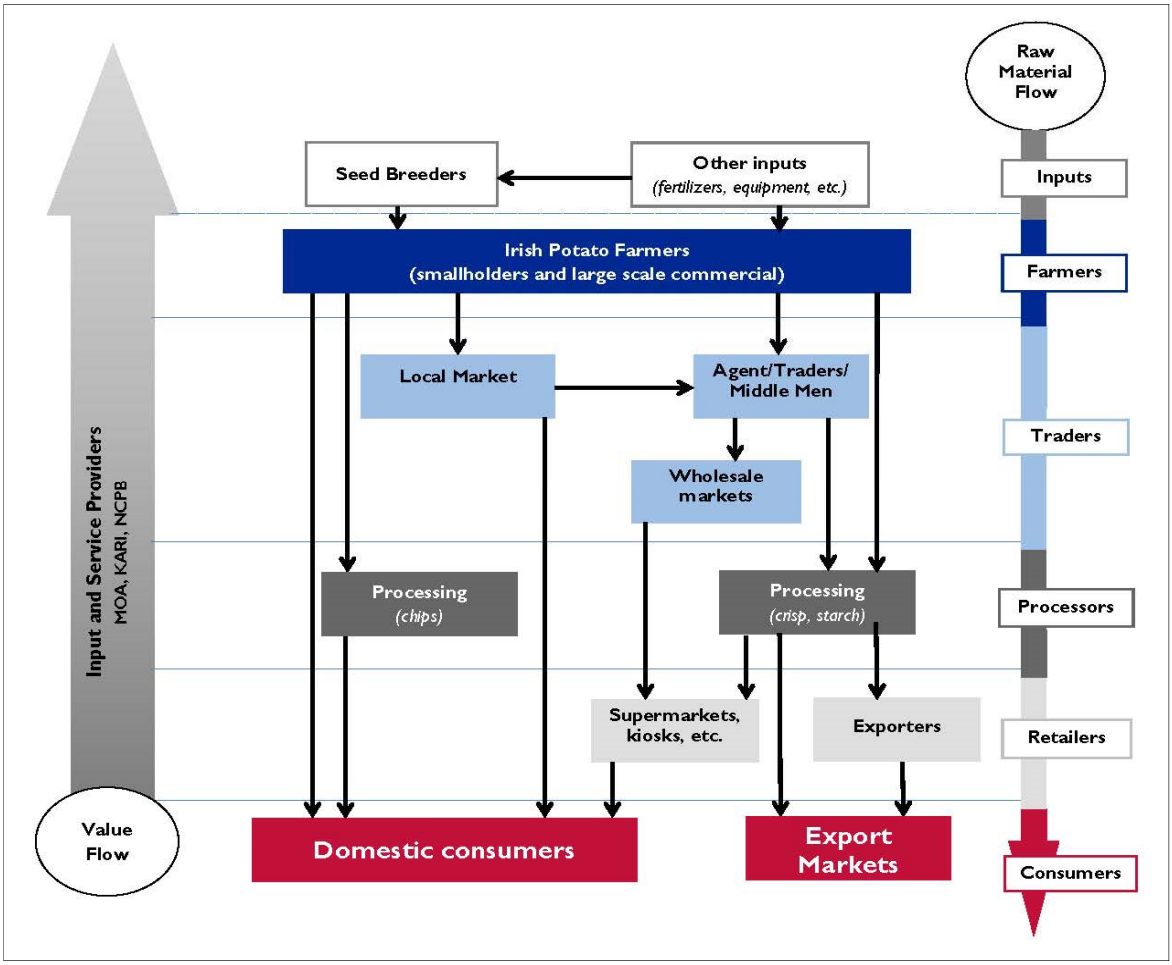
A more detailed survey is needed to disaggregate demand between household consumption and the needs of the increasing number of food service users who use potatoes for a range of cooked dishes. No official data is available but many of these businesses report that they cannot get the high quality of potato demanded by their customers and, for example, are forced to buy imported frozen chips that they need to cook on a daily basis.

# 4 THE POTATO VALUE CHAIN MAP

**In this section, we look at the potato value chain in detail, highlighting key actors, their interactions and critical constraints and gaps, as well as opportunities for USAID-KAVES interventions. For ease of reference, Figure 9 provides a simplified diagram of the potato value chain, showing the basic flow from producers through marketing agents, and processors to the end consumer, as well input and service supplies to the farmer.**

The interaction of multiple, mostly informal actors increases the complexity of analyzing the potato value chain. A range of key stakeholders are involved both at the pre-planting stage (breeders, seed multipliers, and seed traders) and at postharvest (brokers, transporters, traders, and processors). There are approximately 500,000 growers in the country, predominately smallholder, cultivating over 143,000 hectares. They sell their produce mostly through local brokers and to wholesalers, and, to a small extent, to specialized retailers. Among the USAID-KAVES target countries, only Meru has a significant number of medium and large-scale farmers.

**Figure 9: Potato Value Chain Map**




*Source: Ministry of Agriculture*

## 4.1 INPUT SUPPLIERS

Potato production requires high initial investment in inputs. Input suppliers include seed producers, multipliers and traders, local market potato traders, agrovet stores, and fertilizer and chemical suppliers. Within the target USAID-KAVES counties, these input suppliers lack the technical expertise to effectively provide appropriate services, such as training on chemical use, to producers. In some counties, input suppliers are located at such a distance from the farming communities they serve that the cost to access input suppliers significantly dampens demand for these products.[10] Producers' organizations are almost non-existent in potato counties and hence structures for collective marketing and bulk purchasing of inputs are underdeveloped.

High cost of inputs, especially seeds, fungicides, and fertilizers, greatly limit the production of potatoes in Kenya. Seed costs contribute a significant 42 percent of the total production costs (Kirumba et al., 2004).

**Chemical suppliers**: Late blight and bacteria wilt diseases are the most economically significant threat to the potato value chain[11] and thus make chemical suppliers critical value chain actors. Producers rely on various crop protection chemicals to manage diseases. Overuse and misuse of chemicals is rampant across potato production regions. As a root tuber, substantial chemical residue accumulation in potatoes and environmental pollution are serious public health issues in Kenya, largely ignored.

**Fertilizer suppliers**: Rapid decline in soil fertility is a major constraint in potato production among smallholder producers (Kiiya et al., 2006). Smallholder producers apply fertilizer below the recommended rate of 90kg N/ha + 230kg P2O5/ha (Kaguongo et al., 2008). In addition, continuous use of DAP without soil testing in inherently acidic soils has increased soil acidity and thus limits production and mitigates the benefits of additional fertilizer usage (Kamoni, 2009). The specialized nature of nutrient requirements for potatoes requires fertilizer blending. Apart from a few products by MEA Ltd, minimal blending of fertilizers specific to potatoes occurs in Kenya.

**Seed producers:** The actual need for seed potatoes is difficult to evaluate because of use of informal (or farmer-saved) seeds, but current estimates suggest national certified seed potato demand is approximately 48,000 MTs per year (Schulte-Geldermann, 2013). Approximately 96 percent of farmers use informal seed sourced from retained harvest, exchange with neighbors or purchased from markets. It is estimated that less than 2 percent of smallholders use good quality (positively selected and clean seed) seed potato (Kaguongo et al., 2008). Approximately 1 percent of potato farmers use seeds certified by KEPHIS.[12]

A majority of potato producers lack proper information and training on seed selection. The common practice is for producers to select small-sized tubers for seed at harvest, and then sell the medium- and large-sized tubers. This encourages the spread of diseases with each progressive season, and thereby lower yields over time. Viral diseases are common in most potato production areas and infected plants produce small-sized tubers, which most farmers mistake (and select) for seed. Moreover, seed potatoes obtained from neighbors and markets are of doubtful quality and suffer the same risks as farmers' own seed. These sources of seed potatoes have been blamed for the spread of bacterial wilt and other soil and seed borne diseases.

Kenya's seed potato systems are characterized as "minimally functional" due to its small scale. Specialized production of early generation seed occurs at only four locations across Kenya, two managed by the public sector (Agriculture Development Corporation in Molo and KARI in Tigoni), and two by the private sector (Genetic Technologies International Ltd in Nairobi and Kisima Farm in Mt. Kenya region). The network of decentralized seed potato multipliers is also limited, with 30 to 40

[10] This issue is addressed further in the USAID-KAVES Maize Value Chain Report 2014

[11] Bacterial wilt caused by a fungus known as *Ralstonia solanacearum* causes losses of 30 to 70 percent at altitudes of 1800-2800 meters (Otipa et al., 2003).

[12] KEPHIS oversees a centralized formal certification system that certifies principally early generation seed.

multipliers spread over the major potato growing areas (CIP, 2013). KARI-Tigoni is the main source of clean (foundation) seed, but suffers capacity constraints due to the double mandate of research and commercial seed production. The seed it produces is foundation seed for further multiplication by seed potato suppliers.

**Extension services**: While there is no shortage of resources available for research, technology transfer to smallholders has been slow, particularly in the customization, promotion, and adoption of appropriate technologies for different ecological conditions. The government mainly provides potato extension services to train producers on all aspects of potato production, but the linkages between research, extension and producers are generally weak. KARI and CIP are key players in research and technology transfer and work closely with other organizations in the sector. Private potato processors and seed multipliers also provide extension and education services to producers, but these are currently of limited reach. The MOA's extension capabilities are limited by inadequate numbers of staff trained in potatoes and limited funding. Only 14 percent of producers in Nyandarua, for example, reported having received any agricultural advice (CIP, 2005). Of these, the public extension service accounted for over 80 percent, with private traders and companies accounting for the remainder. Given that Nyandarua is the leading potato producing region, we would expect the situation in other producing regions, especially those targeted under USAID-KAVES, to be worse.

The MOA, in collaboration with other stakeholders in the potato industry, has been training producers on clean and positive seed selection and multiplication. **Government extension services are, however, biased toward promoting formally released and certified varieties and discouraging the use of informal varieties. With 96 percent of potato producers using informal seed, such emphasis on certified seed has made extension services largely irrelevant to most potato producers.**

## 4.2 FARMERS

Smallholders are the main producers of potato in Kenya, growing two crops per year (each season is about four months). These producers typically grow potatoes without irrigation on 0.25-0.50 ha plots using mainly manual labor. Potato production follows rainfall seasons with early harvesting of immature tubers starting two months after planting. Pre and postharvest management practices are poor and tend to result in tubers with soft peeling skin that are easily damaged and store poorly.

Like most agricultural produce from the smallholder sector, harvested potatoes are sold immediately, often creating gluts and low prices around harvesting season. Storage is almost nonexistent and periods of glut are often followed by scarcity and high prices a few months later. These high prices peak just before the next planting season. Potato producers mostly interact with local brokers and informal market traders, and a few wholesale traders. Direct interaction with potato processors is minimal. Moreover, potato producers have little influence on the governance of the value chain. Their roles are limited to production, with brokers and traders serving as the main drivers of market behavior and price.

Some producers, especially in Narok and Bomet counties, have established links with market brokers in major wholesale markets, with whom they transact business remotely based on social trust. They send their produce to these traders through their own or hired transporters, who then communicate the prevailing prices for the day, sell the produce, and transmit the net proceeds of the sale, mostly through the mobile-phone based money transfer service M-PESA. Although vulnerable to information asymmetry, the level of trust formed through this channel cuts out local brokers and ensures producers earn higher margins. The margins analysis below shows such an arrangement could earn producers up to 60 percent more per bag of potatoes.

The structure of the potato value chain has elicited complaints from producers over unpredictable and fluctuating prices, poor roads, and the use of extended bags. In a study across major producing areas, Muthoni et al (2013) found price fluctuations the key constraint identified by producers in Bomet and Elburgon, followed by poor roads in Bomet and Molo, and concerns over the use of extended bags,

particularly in Longisa (West Pokot) and Nakuru areas. Prices fluctuate widely across potato producing areas. In Meru, for example, producers receive anywhere from KSh1,500 to KSh4,500 per bag, depending on the season, levels of production, and marketing channels used (IFDC, 2013). In a January 2014 USAID-KAVES RRA of major wholesale markets, market traders quoted purchase prices ranging from KSh1,200 to KSh3,000 per bag (See Table 15 in the Margins Analysis section).

## 4.3 MARKETING ACTORS

Potatoes tend to pass through various markets after leaving the farm-gate and before arriving at the final consumer. Most of it is traded through wholesale markets in Nairobi, Kisumu, Mombasa, and Nakuru. Table 12 summarizes the major potato markets across the country, their source markets, and their destination markets. It shows that most markets source potatoes from target markets in either their immediate vicinity or the same geographical areas. Only Nairobi and Bungoma markets target destination markets outside their geographical proximity.

Informal traders interviewed for this study sourced from both markets and production sites closer to their markets for sale in smaller towns. Nairobi wholesale markets are the most diverse, handling potatoes coming from as far away as Tanzania. Most formal buyers prefer to buy from large- and medium-scale producers given their ability to meet quality specifications, such as wholeness and cleanliness of tubers. USAID-KAVES focus group discussions conducted in 2013 found that producers were keen to meet formal market requirements but were generally unable to do so.

**Table 12: Source and Destination Markets for Potatoes**

| County Markets | Source Markets | Target Markets |
|---|---|---|
| *Bungoma Markets:* Chwele, Bungoma Municipal | Elgeyo Marakwet, Mt. Elgon, Trans Nzoia | Busia, Nambale, Kakamega, Siaya, Kampala, Mombasa |
| *Uasin Gishu Markets:* Burnt Forest, Kipkaren River, Eldoret Wholesale | Chwele, Kapcherop, Keiyo, Timboroa, Burnt forest | Kipkaren, Burnt Forest |
| *Nakuru Markets:* Naivasha Open-air, Nakuru Wholesale | Mau Narok, Narok, Dundori, Molo | Kinangop, Oserian, Kirungu, Magumu |
| *Nairobi Markets:* Kangemi, Muthurwa, Wakulima, City Park, Ngara, Jamuhuri | Narok, Molo, Kinangop, Ngarua, Bomet, Tanzania | Kagwangware, Kitui, Machakos, Garissa |
| *Kisii Markets:* Darajambili, Suneka, Nyakoe | Molo, Gucha, Bomet | Darajambili, Nyakoe |
| *Kisumu Markets:* Jubilee Municipal, Kibuye Wholesale | Kibuye, Bomet, Molo | Ahero, Bondo, Akala, Sondu, Katito, Kakamega |
| *Meru Markets:* Mitunguu, Nkubu, Gakoromone, Kariene, Ntharene | Meru, Naro Moru, Timau | Meru, Kibirichia, Endarasha |

*Source: USAID Kenya Agricultural Value Chain Enterprises (USAID-KAVES), 2013*

In Nairobi, Wakulima market is the largest wholesale potato market and handles a yearly average of 78 trucks per day, rising to 120 trucks during the high season and down to 50 trucks in the low season (Table 13). Other major markets in Nairobi include Wangige, Kawangware, Gikomba, Kangemi, and Toi. Wangige and Gikomba receive an average of 30 trucks per week, while the other markets get 15 to 20 trucks. About 60 percent of potato marketed in Nairobi is from Nyandarua, 20 percent from Narok and Bomet, and the rest from Nakuru and Meru (Kirumba et al., 2004). Surveys of long time traders at Wakulima market indicated that approximately five trucks leave the market for other towns like Garrisa, Mombasa, and Kitui daily.

**Table 13: Ware Potatoes Flow into Nairobi Markets**

| Market | Average Number of Lorry-loads (5.6 tones) per day | Metric Tons per day | Kilograms per Year |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Wakulima | 78 | 436.8 | 159,432 |
| Gikomba | 4 | 22.4 | 8,176 |
| Kangemi | 2 | 11.2 | 4,088 |
| Wangige | 3 | 16.8 | 6,132 |
| Dagoretti | 3 | 16.8 | 6,132 |
| Kawangware | 5 | 28.0 | 10,220 |
| Toi | 2 | 11.2 | 4,088 |
| Total | 97 | 582.0 | 212,430 |

*Source: Kirumba et al.*

**The Meru Retail Market**

*The Meru retail market operates three days a week: Monday, Wednesday, and Friday, with Monday and Friday as the main trading days. The volumes of potatoes on any market day are between 1,000 and 2,000 bags. The traders buy direct from producers in the growing areas (Kibirichia, Nari, and Timau) and use pickups, small lorries or donkey/bullock carts to transport potatoes to the market. Most of the produce is sold to traders coming from smaller towns in the area (Nkubu, Maua, Isiolo, Chuka, Chogoria, and Embu). Sometimes producers bring up to 10 bags for sale using their own donkey or bullock carts. The following summary describes the movement of potatoes produced in Meru to the final consumer.*

**Farm-gate:** Producers sell in small lots of five to 10 bags. A local broker acting on behalf of traders from Nairobi and other neighboring districts arranges most of the sales. Traders from local markets and the main district market also come to buy directly from producers.

**Transhipment:** Due to enforcement of legal notice number 44 (2005) and 113 (2008) by the local government, traders buying from producers in Meru are forced to use 100 kg bags. However, the main Nairobi market requires an extended bag. The bags are therefore transshipped and off-loaded in Nanyuki, opened, and extended by using a sisal net extension woven on top of the bag. The bag is topped up with potatoes to weigh about 130 kg. From every 100 "flat bags" traders get 72 extended bags.

**Wholesale Markets:** The main destination market is the wholesale market of Wakulima in Nairobi. Built in the 1960s, the Wakulima is now too small for the volume of potato trade forcing traders to conduct much of their business in the streets surrounding the market. Lorries arrive at night from 11pm onwards to deliver their consignments. Drivers then hand over the loaded lorries to resident brokers, who undertake the marketing, and then leave the market. When the market opens at 4 a.m., brokers sell by the bag from the back of the lorry. Other major markets include neighboring districts where potatoes are not grown. Nairobi is also a transshipment point for other centers, especially the coastal town of Mombasa and northern regions and Somalia through Garissa.

**Retail Markets:** Potatoes are sold mainly in open-air markets at trading centers and in small neighborhood shops or kiosks. Only about 2 percent of all traded potatoes pass through retail markets.

**Street Markets:** Hawkers sell by the tin to consumers, and minor retailers take some of the produce entering the markets. Roadside markets along major highways passing through producing areas are popular points of retail.

*Source: GTZ, 1998*

### 4.3.1 Brokers and Agents[13]

Brokers and agents maintain considerable control over the local potato trade. Minimal trade happens without their playing some sort of intermediary role. Most potato wholesalers, transporters and

[13] This section is based on Foodnet (2002).

processors have set up their own networks of brokers across the production areas to ensure smooth and consistent supplies of produce.

***Village-level Agents and Brokers***: In the producing areas, they consist mainly of young men from surrounding areas, who may be brokers on their own or agents of bigger brokers in the region. They live within the production areas, are easily accessible, and are well known by the producers. As such, there is an element of social trust built over time through repeated interaction. The brokers receive orders, either directly from wholesalers or from their networks of other brokers, at an agreed price two or three days in advance of the next trip, and assume the responsibility for procuring potatoes in properly filled bags of acceptable quality. Using the agreed price, they determine the price paid to producers (which is the difference between the agreed price and their mark-up), and scout for producers to supply potatoes. They may pay a deposit to secure producers commitment to supply a certain number of bags. The broker walks from farm to farm negotiating with each producer for a specific number of bags. Since farm sizes are small and producers are fairly spread apart, brokers often walk for long distances to ensure that their orders are met. According to producers interviewed for this report, brokers closely monitor the production cycle and will approach producers to initiate harvesting.

The broker supplies the producer with the requisite number of bags, which are then collected at the farm-gate during good weather or assembled at market centers close to good roads during the wet season. After harvesting, the producer packages the non-seed sizes into the bags, refraining from including the large-sized tubers. The full potato bag is carried to the farm gate closest to the road on bicycles, donkey carts, or handcarts. The large tubers are placed on the ground next to the bag. The broker comes back to the farms with sisal twines, and sews up each bag by placing the large tubers on top in a net-like extension to make the bag attractive to buyers. After sewing, the broker leaves the bags on site and moves to all the farms where he has contracted producers and repeats the process. The potatoes used in the "extension" are never paid for, meaning brokers and traders get 20-60 kg of potatoes for free.

In the evening (usually late in the night), the broker comes with a truck and picks up all the bags while paying the producers. The broker and the lorry's driver are responsible for loading. When collecting the bags, the broker will, in some cases, renege on the agreed price, usually on the pretext that the market situation has changed. In certain cases the broker will not come back for a couple of days citing transport problems and will then usually lower the price claiming the potatoes are now "old" or "no longer fresh" (Foodnet, 2002). When the broker does not come back on the same day, it is the producer's responsibility to cover the potatoes to prevent them from greening. The intermediary role played by village brokers ensures potato producers never interact directly with traders, and forces producers to be price-takers. This market arrangement curtails the flow of critical market information and denies the producer opportunities for better prices.

***Buying Agents:*** These are intermediaries buying for restaurants, institutions, and processors. They have regular orders to fulfill and are paid an agreed commission each month. The bigger agents may have fixed price contracts for periods up to three months or longer, paid on a monthly basis. The smaller agents may only deal with five bags per day. These buyers have a quality requirement similar to the Aga Khan women (see text box on next page) but tend to find one producer (or a few producers) with fairly expansive good crop area to supply over a longer time. They then source their potatoes from the one producer (or producers) throughout the season. At the wholesale markets, the smaller agents usually sort and re-bag the potatoes to meet quality standards of their clients, and in the process sell potato "rejects" to retailers in 17-kg baskets

***Aga Khan Women**:* As the name implies, these are women who trade at the City Park market opposite the Aga Khan Hospital in Nairobi. They buy potatoes with a greater quality emphasis. They not only buy fewer bags than brokers but also select the potatoes directly on the farm. They do not take small-sized or damaged tubers and usually pay better than the brokers. They do not fill up a bag like the brokers, but instead have half-filled bags tied with twines. Producers with good potatoes prefer them but those with poor quality produce find their potato grading uneconomical and undesirable. The women negotiate with a few producers and come back during the harvest to select the tubers they will buy. The women then hire a lorry to collect potatoes from the farm and another to transport them to Nairobi. They sell the potatoes to retailers at the City Park market on Tuesdays and Fridays. Since their potatoes are good sized and clean, the Aga Khan women receive a price premium compared to other wholesalers.

*Market Brokers:* At the wholesale market level, another set of market brokers has established full control of potato marketing. Potatoes are transported from production areas and sold from the back of trucks at the various wholesale markets. In Nairobi, brokers approach the lorry operators and agree to sell the potatoes at an agreed price for a certain commission, usually KSh20 per bag. The established practice is for the transporters to hand over the lorry consignment to market brokers upon arrival. The brokers then perform the marketing and sales, and then hand over the proceeds to the relevant truck drivers. These brokers know the buyers and have their own established network of retail and institutional clients. They often work as a team scouting for customers, while one sits on the lorry collecting the money. Direct selling by wholesalers is uncommon.

### 4.3.2 Transporters

Potatoes are normally transported in lorry trucks of capacity ranging from 3.5-ton to 7-ton, and in a few cases 12-ton lorries. Due to lower unit cost per consignment, larger lorries are more profitable. Transporters include traders and brokers who play a key role in aggregating, packing and transporting potatoes from the production areas to the main urban markets in Nairobi, Mombasa, Kisumu and Nakuru. They tend to integrate forward and backward into the marketing of potatoes by performing more market functions in order to improve on their profit margins. In some cases, transporters double up as wholesalers – procure potatoes on their own, and then transport and sell at wholesale or retail markets.

Lorry owners seek to have a full load both legs of the journey. Before leaving the production areas, they often secure orders to bring back merchandise for local stores and businesses. In high-volume producing areas, like Meru, the hire rates are fairly constant throughout the year, and there is no problem of availability of transport. Traders owning their own transport can transport 50 to 100 bags per day (1 bag ≈ 140 kg), depending on vehicle capacity. Smaller traders combine to hire transportation and may move 20 to 30 bags each, depending on capital and the potato season.

For this report, we did not interview potato transporters but it is a group of market actors worth studying and understanding. For example, among others, issues about the cost of operating the transportation business, rural infrastructure constraints, capacity constraints, availability of return cargo, and the effect of potato market structure on their business would be useful for USAID-KAVES interventions along the value chains.

### 4.3.3 Wholesale Traders, Institutional Agents and Retailers

***Wholesalers*** are responsible for procuring and moving potatoes from production areas to the various wholesale and institutional markets. The traders, mostly men, usually buy from the area of their origin, and often own the lorries on which the potato is collected. Some of the small traders who do not own lorries combine to hire a lorry. The traders contact village brokers and supply them with bags for the producers, and agree on the price at which they will buy. On the appointed day, they collect from the farm assembly points. At the market, wholesalers, retailers and hawkers sell to consumers, usually in heaps and tins weighing about 15 kg. A wholesaler may deal in 20 to 30 bags per day, which means a small lorry-load may take 1-2 days to sell.

Wholesaling challenges include high prices charged by brokers/suppliers, price negotiations (long and unfruitful haggling), substantial price fluctuations, and fierce competition from other buyers, especially during low supply seasons. Selling problems include competition from other sellers, poor sales during supply gluts, price negotiations and debt default. Other challenges relate to market losses as a result of storage, while wholesalers sometimes forced to sell at lower prices to avoid spoilage. To partly deal with these challenges and organize the market, wholesalers have formed informal groups/associations – mostly informal credit groups, followed by trader welfare associations, and potato wholesaler groups.

***Retailers*** usually sell in heaps and tins, although in some markets potatoes are sold in kilograms. They are mostly women and can sell half to one bag per day. Other retailers purchase potatoes for other markets. Retailers interviewed take an average of four days to sell their potato stock, resulting in storage losses mainly from rotting and greening of tubers. Retailing challenges include pricing by the supplier, issues of poor quality potatoes due to poor quality tubers and lack of grading standards by supplier. Retailers also face problems with their final consumers, mainly on the price (prolonged haggling), competition from other sellers, and potato quality.

***Porters loading, unloading and transporting potatoes:*** At each transshipment point vehicles are loaded and unloaded, and established rates have to be paid. It is usually KSh30 per bag to load a vehicle and KSh20 to unload. At the markets, buyers and retailers pay porters to move their merchandise to other markets or to various transportation points. This is done manually through human-carry or handcarts.

### 4.3.4 Processors

Potato is mainly processed into crisps and chips. Other processed products include long-life (frozen) fries and potato flour (Riungu, 2007). Approximately 12-15 percent of total national potato production goes into processing, with chips making up 90 percent of this (Tesfaye, A., et al., G., 2010). Processing of potato flour, starch, weaning food and wine is yet to be commercially exploited in Kenya.

It is estimated that there are over 800 restaurants selling chips in Nairobi, with similar establishments in other major towns. About 60-65 percent of the fresh potato supplied by urban traders is processed in fast food outlets, such as restaurants and street stalls (Tesfaye *et al.*, 2010; Kirumba *et al.*, 2004). A study of a few takeaways and restaurants in Nairobi found that each of these facilities sells an average of 3-5 extended bags (130 kg) of potato per day and slightly more during weekends and public holidays. This is equivalent to about 2,500 bags per day or 30 (7-ton) lorry loads per day (Tesfaye *et al.*).

> Most potato processing varieties (Tigoni, Shangi, and Desiree) are low yielding and highly susceptible to pests and diseases (Potato Value Chain Report, 2012). KARI has collaborated with processors and developed new higher yielding varieties with attractive processing quality features. These include Pink Gold, Kenya Sheherekea, and Kenya Mpya. But the adoption of these new varieties remains low.

The main potato processors such as Midlands, Deepa, Norda, and Njoro Canners are operating at about 40 percent capacity due to inconsistent supply of good quality tubers, which is attributed to reliance on rain-fed production system and inadequate storage facilities (Oiko Credit, 2010). Midlands, for example, produces pre-prepared (peeled and prepared into required shape) potatoes products that are vacuum sealed but plans to expand to other products including animal feeds, starch etc. It has the capacity to process up to 6,000 MT per season but currently operates at about 65 percent due to shortages of suitable processing varieties.

There are about forty potato crisp processors located in Nairobi, led by Deepa industries, Shakti industries, Top SS and Crispy Crisps. On average processing yield for crisps are about 20 percent, with about 1kg of potatoes giving approximately 200g of crisps. This market is served almost exclusively with premium Dutch Robijn (alias Bomet or Golof) potatoes from Bomet. Other acceptable varieties include Arka, Kerr's Pink and Desiree.

Most institutional buyers rely on large producers to deliver the produce to their premises (31.7 percent) while brokers (25.4 percent), traders delivering to buyers' premises (17.5 percent), sub-contracted producers (12.7 percent) supply the rest, with another 12.7 percent sourced directly from local markets. USAID-KAVES found that potato processing exerts little direct influence on producers but presents an interesting opportunity as new processing companies establish dedicated supply and distribution chains (from farm to markets). Participants in the USAID-KAVES focus group discussions proposed that processors and institutional buyers pursue contract farming to ensure consistent supply and enhance market reliability for smallholders. In Bomet County, USAID-KHCP has helped expand an earlier initiative with KARI, MOA, and CIP on market linkages with Deepa Industries, a leading processor of potato crisps, which has seen the company increase monthly purchases from 400 to 900 bags (110-kg) from 300 contracted farmers (FINTRAC USAID-KHCP Snapshot April 2013). In Meru County, a new company, Sparta Foods Ltd, which processes and supplies whole, peeled and sliced potatoes to hotels and restaurants, is organizing producers into clusters to build a stronger potato value chain capable of meeting its supply needs. If successful, the contract farming arrangement will engage about 5,000 smallholders to supply up to 450 metric tons of potatoes per month.

## 4.4 SUMMARY OF FINDINGS

Potato marketing faces several constraints, including cartel-like behavior among local produce buyers, poor storage infrastructure, distorted and unpredictable prices, lack and/or poor enforcement of standards on quality and packaging, and information asymmetry that fosters strong networks of brokers and traders (see box).

***Constraints at the marketing level:***

- Perishability of tubers harvested before attaining physiological maturity;
- inadequate on-farm storage facilities;
- Poor access roads;
- Poor infrastructure in public wholesale and retail markets;
- Low adherence to packaging standards;
- Inadequate access to market information; and
- Low farmer bargaining power.

Potato marketing channels are "well" organized into cartel-like structures and appear efficient on the surface. The market organization is so effective to the extent it shuts out new entrants and ensures potato producers have limited bargaining power and obtain low returns. The channels shield producers from receiving sufficient market information and capturing higher shares of the final price. The packaging of potatoes, especially the use of extended bags, is also a major impediment to higher producer returns. In many counties, producers are forced to package potatoes in extended bags of 120-150 kilograms on average, but receive prices that are equivalent to 110-kg bag. Although tariffs (formal and informal), wastage and dehydration losses are undoubtedly factors driving the lack of transparency and standards relating to weights, the much diputed potato bag is distracting attention from the more significant factors of sub-optimal yields and poor average quality.

Given the existing market structure, there is need for organizing growers in producer groups and linking the groups to alternative markets. Enhanced farmer organization will facilitate capacity building, acquisition of inputs, implementation of structured marketing arrangements, and enforcement of the legal notice on packaging of potato. Strong producer groups with high levels of production of quality potatoes may be the best players to exert pressure on the current inefficient systems that inhibit change towards a more quality driven industry.

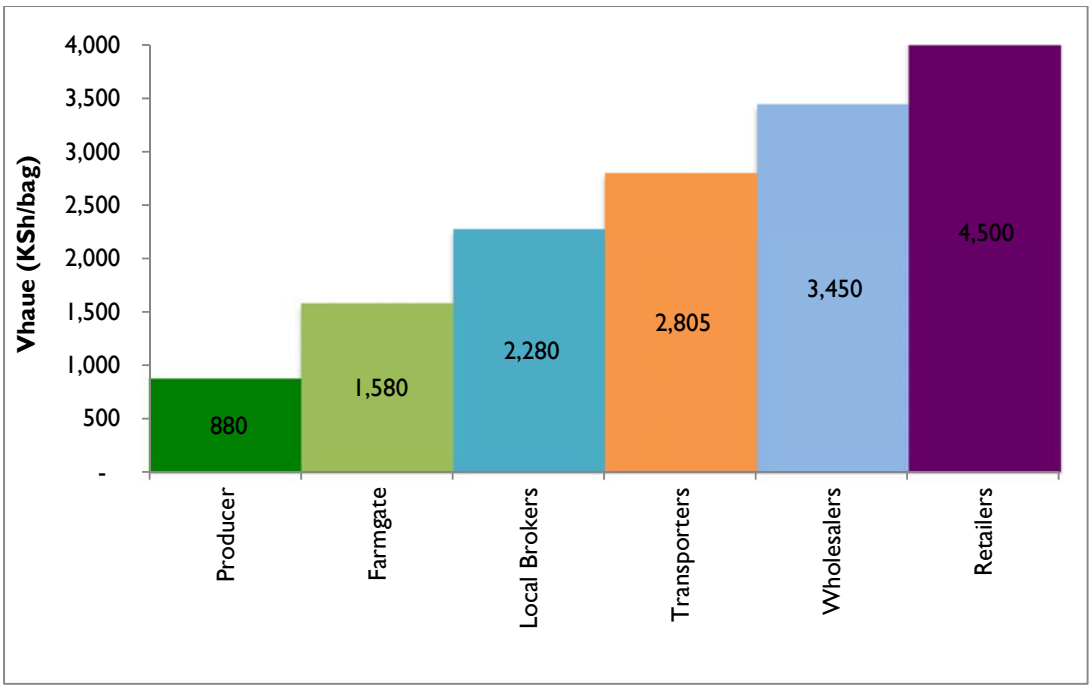
# 5 MARGINS ANALYSIS

**In this section we look at gross margins along the value chain. In order to do this, we conducted RRA surveys in 2013 and 2014 of producers, assemblers, wholesalers, and retailers, and used data collected from producer respondents of the USAID-KAVES Baseline Survey (2013). The surveys considered a number of variables, which were then used in calculating cost of production, including inputs, labor, and transport.**

## 5.1 POTATO VALUE ACCUMULATION

From analysis of the USAID-KAVES RRA and Baseline Survey data, the value accumulation picture in Figure 11 emerges. Value chain players generate a total of KSh3,370 per bag of potatoes from the farm to the final consumer, translating to 4.8 times the farm value of potatoes.

**Figure 11: Potato Value Accumulation**



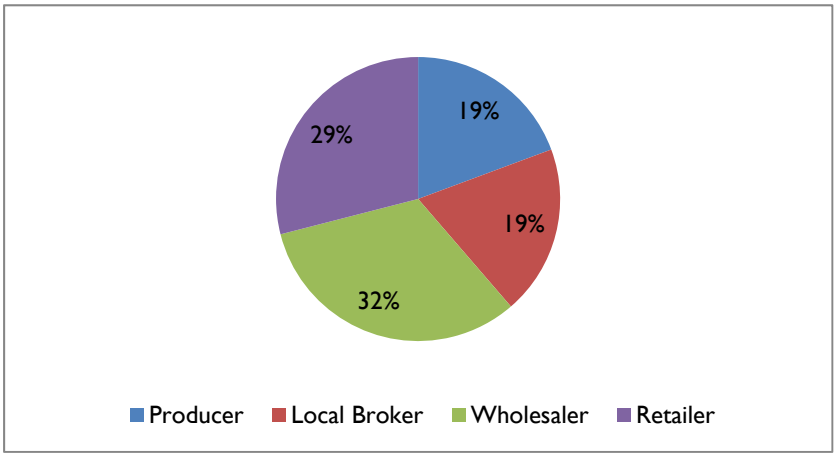

*Source: USAID-KAVES Estimates from Baseline Survey, 2013 and Markets RRA, 2014*

Figure 11 shows that farmers added 80 percent to the value of their produce, brokers added 44 percent, wholesalers 51 percent, and retailers 30 percent. In terms of the distribution of the total value added, Figure 12 indicates the wholesalers contributed the largest share (32 percent), followed by retailers (29 percent), and producers and brokers (19 percent each). A large component (47 percent) of the wholesaler contribution is due to substantial transportation cost, which can be anywhere between KSh300 to KSh700 per bag depending on the distance and condition of roads. At 32 percent and 19 percent, respectively, and given the short turnarounds in their operations, wholesalers and brokers appear to gain most from potato value chain (see Table 17 - Estimated Earnings from Potato Enterprises per Crop Cycle). These points are explored further with margins analysis in sections that follow.

The high mark-ups at the source and retail markets is indicative of the presence of multiple layers of brokers at both ends of the value chain. Reducing inefficiencies at these levels could significantly lower the final consumer prices and/or improve producer prices. Any interventions targeted at improving the potato sector must consider these results, especially those related to new investments in potato

seed production. **At the current levels of return, most producers will not invest in more expensive seed or other technologies without improved price incentives**.

**Figure 12: Share of Potato Value Accumulated**




*Source: USAID-KAVES Estimates from Baseline Survey, 2013 and Markets RRA, 2014*

## 5.2 PRODUCERS GROSS MARGINS

This analysis estimated a crop budget for a typical smallholder potato farmer producing 7.6 tons per acre and receiving an average farm gate price of KSh10 per kilogram. It indicates that returns per acre per crop cycle would be KSh12,400 (US$144) when all labor is hired, and as high as KSh48,400 (US$562) per acre with family labor and own seed (Table 14).

**Table 14: Potato Production Budget per Acre**

| Activity/Input | Value (Ksh) | Share | Note |
|---|---|---|---|
| Seed | 24,000 | 44% | *Assumes purchase of clean potato seeds* |
| Fertilizer | 12,688 | 23% | *DAP and foliar* |
| Agrochemicals | 5,256 | 10% | *Mainly fungicide* |
| Labor | 12,000 | 22% | *Hired labor* |
| Other | 539 | 1% | |
| Total direct costs | 54,483 | | |
| Yield (kg) | 7,600 | | *Low, can increase with better practices;Two crops per year are possible* |
| Production cost KSh/kg | 7.17 | | *Does not include indirect costs* |
| Price - KSh/kg | 10 | | |
| Gross Revenue | 76,000 | | *High return on labor and investment* |
| Gross Margin | 21,517 | | |
| Seed (kg) | 912 | | *Assumes 12% retained as seed* |
| Marketable Output (kg) | 6,688 | | *Total including home consumption* |
| Net Revenue | 66,880 | | |
| Net Margin | 12,397 | | |
| Net Margin (own seed) | 36,397 | | *If retained seed used* |
| Net Margin (own seed + family labor) | 48,397 | | *Family labor used* |

*Source: USAID/KAVES estimates*

Our analysis of potato crop production budgets using focus group discussions in three counties (Meru, Uasin Gishu, and Bungoma) shows the average total budget for an acre of potatoes is KSh29,325 (US$345), with a net income of about KSh17,000 (US$200) per crop cycle (Table 15). The largest

contributors to the total cost of production include labor, soil fertility management (fertilizer and manure), and pest and disease control. The combined cost of labor – land preparation, weeding, spraying, harvesting, and transportation, constituted the largest cost item (43 percent), followed by (organic and inorganic) fertilizers (22 percent). The heavy dependence on pesticides for disease and pest control in potato production is evident in the cost of agrochemicals (KSh4,225), which formed the single largest cost item (14.3 percent).

Our analysis shows the farmers realized a net margin of 37 percent over the revenue, producing a bag of potatoes at an average cost of KSh983 and selling at a KSh1,550 per bag, at a margin of KSh567. Due to high postharvest costs incurred directly after potatoes mature and liquidity constraints, producers are vulnerable to selling at low farm gate prices to meet these costs. In some cases, the crop is harvested prematurely, resulting in low-quality, low-value produce. **Liquidity support and better harvesting management could yield greater returns on the margin for producers.**

**Table 15: Margins Analysis for an Acre of Potatoes**

| Yields per acre (bags) | 30 | | |
|---|---|---|---|
| Cost items: | Amount (KSh) | Amount (USD) | Cost share |
| Land preparation | 3,675 | 43.24 | 12.5% |
| Cost of seeds | 3,000 | 35.29 | 10.2% |
| Fertilizers | 3,500 | 41.18 | 11.9% |
| Manure | 3,000 | 35.29 | 10.2% |
| Four weedings | 2,475 | 29.12 | 8.4% |
| Chemicals | 4,225 | 49.71 | 14.3% |
| Spraying | 625 | 7.35 | 2.1% |
| Harvesting | 4,000 | 47.06 | 13.6% |
| Packaging | 1,825 | 21.47 | 6.2% |
| Transportation | 3,175 | 35.29 | 10.8% |
| *Total cost* | 29,500 | 345 | |
| *Cost per bag* | 983 | 11.57 | |
| Farm gate price per bag | 1,550 | 18.24 | |
| Gross margin per bag | 567 | 6.67 | |
| Total revenue | 46,508 | 547 | |
| Net income | 17,008 | 200 | |
| % Margin | 37% | | |

*Source: USAID Kenya Agricultural Value Chain Enterprises (USAID-KAVES), 2013*

We used the USAID-KAVES Baseline Survey 2013 database to verify the above potato production budgets and margins. The survey considered a number of variables in calculating the cost of production, including land preparation, fertilizers, pest and disease control, harvesting and transportation. Only samples in Meru, Bomet, and Elgeyo Marakwet counties captured enough potato producers to permit analysis. We use county averages of producer reported data to estimate practices of the average potato producer. In cases of inconsistencies, USAID-KAVES field staff was consulted to check the accuracy of the information. The aim is to gain a degree of understanding of the actual practices of potato producers across the FTF target counties. We first convert the data to per acre basis and then compute returns per unit farm per crop.

Our analysis reveals that the leading drivers of production costs include labor, seed potato, and fertilizers. For the three counties analyzed, labor constituted 36 percent of total cost, followed by seed (22 percent), and fertilizers (15 percent). Labor cost shares are 32 percent in Bomet, 42 percent in Meru and 43 percent in EMC, while seed cost shares range from 9 percent in EMC to 29 percent in Meru, respectively (Table 16). Gross margin analysis shows potato farming is highly profitable with margins ranging from KSh9.40 per kg reported in Meru to Ksh10.40 per kg in Elgeyo Marakwet and

Bomet. On average, the cost of producing one kilo of potatoes is KSh5.86, with average farm gate prices from the sampled counties ranging from KSh14 to KSh18 per kg.

Average gross margin per acre for the sample was found to be KSh56,601, spread over four months (120 days), including land preparation, planting, and harvesting. The highest gross margins per acre are obtainable in Meru (KSh72,858) and the lowest in EMC (KSh47,561). Adjusted for plot size, this translates to an average of KSh35,281 per farm for the three counties. Potato farmers realized 63 percent gains from potato production and about 163 percent return on investment (ROI). When annualized (2 crops per year), farmers are realizing an average ROI of 346 percent – with the highest (495 percent) obtainable in EMC.

On average, the cost of producing one kilo of potatoes is KSh5.86, with average farm gate prices from the sampled countries ranging from KSh14 to KSh18 per kg.

**Potato enterprises were the only source of livelihoods for farm households, the total gross margin after two crop cycles could meet 56 percent of the annual consumption expenditure requirements of an average household of five, living just above the rural poverty line (KSh1,900 per adult per month).** If the average producer sold 67 percent of the total potato produce, they would realize a net income of $128 per crop. Such a producer would need to plant about two acres of potatoes per year to meet household consumption needs. Results contained on Table 16 further show the impact of increasing average yields. For example, were average yields to increase by 30 percent, producers could realize 88 percent increase in income and reduce the current average land size required to meet the minimum household needs by 32 percent. With proper income diversification that reduces potatoes share of household consumption expenditure to only 30 percent, potato producers would need no more that one-quarter of an acre per crop.

**Table 16: Producer Gross Margins for Selected FTF Counties**

| County | Meru | | Bomet | | Elgeyo Marakwet | | Average | |
|---|---|---|---|---|---|---|---|---|
| Plot Size in acres (range) | 0.9 (0.25, 2) | | 0.55 (0.25, 1) | | 0.42 (0.25, 0.5) | | 0.62 | |
| Yield (kg/acre) | 7,782 | | 4,949 | | 4,592 | | 5,774 | |
| Yield (t/ha) | 19.2 | | 12.2 | | 11.3 | | 14.3 | |
| Cost details: | KSh | Share | KSh | Share | KSh | Share | KSh | Share |
| Seed | 10,417 | 29% | 10,067 | 27% | 1,867 | 9% | 7,450 | 22% |
| Fertilizer | 6,406 | 18% | 5,600 | 15% | 3,700 | 17% | 5,235 | 15% |
| Harvesting | 5,972 | 17% | 2,800 | 7% | 4,000 | 19% | 4,257 | 13% |
| Land Preparation | 4,379 | 12% | 3,200 | 9% | 3,919 | 18% | 3,833 | 11% |
| Mech. Land Prep. | 2,333 | 6% | 4,333 | 12% | 3,000 | 14% | 3,222 | 10% |
| Agrochemicals | 2,148 | 6% | 3,420 | 9% | 900 | 4% | 2,156 | 6% |
| Weed Control | 2,494 | 7% | 2,400 | 6% | 1,333 | 6% | 2,076 | 6% |
| Fertilizer Application | 325 | 1% | 3,600 | 10% | | 0% | 1,963 | 6% |
| Land Lease | | | | | 2,400 | 11% | 2,400 | 7% |
| Materials | 1,616 | 4% | 2,000 | 5% | 200 | 1% | 1,272 | 4% |
| Total cost | 36,090 | | 37,420 | | 21,319 | | 33,864 | |
| Cost per kg | 4.64 | | 7.56 | | 4.64 | | 5.86 | |
| Selling price per kg | 14.00 | | 18.00 | | 15.00 | | 15.67 | |
| Total revenue | 108,948 | | 89,082 | | 68,880 | | 90,465 | |
| Gross Margin/acre | 72,858 | | 51,662 | | 47,561 | | 56,601 | |
| *GM per crop* | 65,572 | | 28,414 | | 19,976 | | 35,281 | |
| *GM per 130-kg bag* | 1,217 | | 1,357 | | 1,346 | | 1,275 | |
| *GM %* | 67% | | 58% | | 69% | | 63% | |
| *ROI* | 202% | | 138% | | 223% | | 167% | |
| Production Cycle (2 crops/year) | 0.329 | | 0.329 | | 0.329 | | 0.329 | |
| *Annualized ROI* | 437% | | 274% | | 495% | | 346% | |
| Available produce (90%) kg | 6,303 | | 2,450 | | 1,736 | | 3,239 | |

| County | Meru | | Bomet | | Elgeyo Marakwet | | Average | |
|---|---|---|---|---|---|---|---|---|
| Retained for home consumption, incl. 8% losses (23%) kg | 1,611 | | 1,024 | | 951 | | 1,195 | |
| Marketed – 67% (kg) | 4,693 | | 1,425 | | 785 | | 2,044 | |
| Revenue (KSh) | 65,696 | | 25,656 | | 11,778 | | 32,024 | |
| Cost (KSh) | 32,481 | | 20,581 | | 8,954 | | 21,108 | |
| ***Net Income per crop (KSh)*** | **33,214** | | **5,075** | | **2,825** | | **10,916** | |
| ***Net Income (US$)*** | **391** | | **60** | | **33** | | **128** | |
| Minimum household (5 members) annual consumption needs (KSh) | 114,000 | | 114,000 | | 114,000 | | 114,000 | |
| GM as % of total annual consumption needs (over 2 crop cycles) | 104% | | 45% | | 32% | | 56% | |
| Viable farm size (acres), potatoes only source of income | 1.56 | | 2.21 | | 2.40 | | 2.01 | |
| Viable farm size per crop cycle (acres), potatoes only source of income | 0.78 | | 1.10 | | 1.20 | | 1.01 | |
| Viable farm size per crop cycle (potatoes is 50% of consumption) | 0.39 | | 0.55 | | 0.60 | | 0.50 | |
| Viable farm size per crop cycle (potatoes is 30% of consumption) | 0.23 | | 0.33 | | 0.36 | | 0.16 | |
| ***Assuming 30% Increase in Average Yields:*** | | | | | | | | |
| *Additional produce available (kg)* | 1,891 | | 735 | | 521 | | 972 | |
| ***GM per crop (KSh)*** | **94,988** | | **43,113** | | **28,655** | | **52,198** | |
| ***Net Income (US$), if 67% of output is marketed*** | **623** | | **150** | | **75** | | **241** | |
| *Increase in net income* | 59% | | 152% | | 125% | | 88% | |
| Viable farm size per crop (acres) - potatoes only source of expenditure | 0.54 | | 0.73 | | 0.84 | | 0.68 | |
| Viable farm size per crop - potatoes is 50% of expenditure | 0.27 | | 0.36 | | 0.42 | | 0.34 | |
| Viable farm size per crop - potatoes is 30% of expenditure | 0.16 | | 0.22 | | 0.25 | | 0.11 | |
| *Percent change in viable farm size* | -31% | | -34% | | -30% | | -32% | |

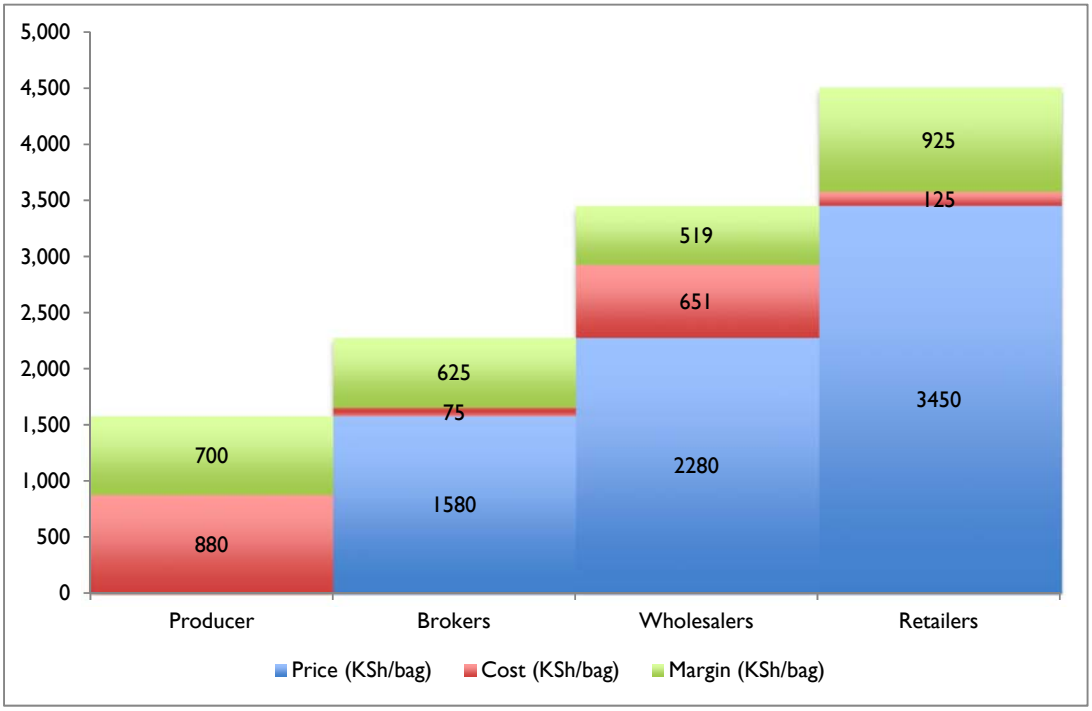
*Source: USAID-KAVES estimates from Baseline Survey 2013*

## 5.3 INFORMAL MARKETS AND TRADERS MARGINS

It is difficult to calculate the margins for traders due to the inexactness of the bag measurement used. Traders buy potatoes per extended bag but sell in smaller packages, e.g. normal-sized bags, buckets, nets or tins. The extended bag therefore offers traders greater volume advantages, often at the expense of producers. Haggling over selling prices is common at both the wholesale and retail points. When wholesalers sell by the tin, they frequently add potatoes from another tin, to give the impression one is getting more for their money, but, oftentimes, the containers are rigged to contain fewer potatoes than paid for.

The information presented in this section is a rough estimation based on available data of trader margins. It is derived from the USAID-KAVES Value Chains Assessment Report (2013) and data collected in January 2014 from key informants at major wholesale markets. In terms of value distribution, Figure 13 breaks down the potato price at each stage into cost and margins. It shows producers take the highest margins at KSh567 per bag (37 percent), followed by retailers at KSh925 (24 percent) and brokers KSh470 (23 percent). Although wholesaling seems to generate only 6 percent in margins, it is likely they compensate with gains from the extended bags.

**Figure 13: Potato Value & Margins Distribution among Market Actors**



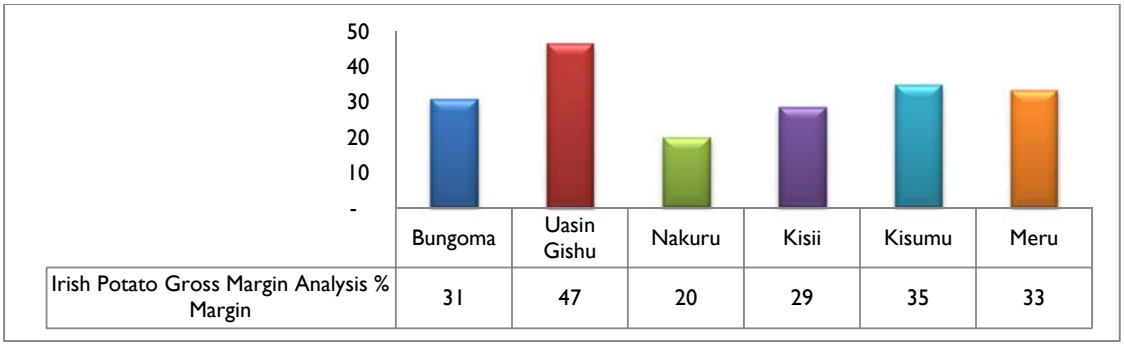

*Source: USAID-KAVES Estimates from Baseline Survey, 2013 and Markets RRA, 2014*

Traders are generally reluctant to provide accurate information on their costs and operation, so any estimates of margins should be treated with caution.. This became apparent during the RRA market surveys, where a respondent at Wakulima market provided cost information that exactly matched the sales price, and then added a loss of KSh135 per bag. Traders are also known to estimate that a bag contains 7 to 8 tins, which yields almost zero margin, but market studies have found nine to 10 tins in most bags (CIP, 2005, KAVES 2014). For every bag, therefore, wholesalers could be getting 1-3 more tins (15-45 kg) as pure profit. At KSh23 per kg, this could earn traders between KSh345 and KSh1,035 per extended bag although tariffs (formal and informal), wastage and dehydration losses are undoubtedly factors driving the lack of transparency and standards relating to weights and margins.

The KAVES Value Chain Assessments (2013) found retailers from Uasin Gishu had the highest gross margins (47 percent) followed by Kisumu traders (35 percent), largely owing to their greater distance

from the main potato sources (Figure 14). Traders in Nakuru and Kisii Counties obtained the lowest margins, perhaps an artifact of their proximity to several production areas in Nakuru, Bomet, Kericho, Kisii etc. Markets located in production areas get direct supplies from producers, as well as attracting a higher number of traders, and hence greater competition for available potatoes. Moreover, since most households produce and retain potatoes, the effective demand would naturally be lower.

**Figure 14: Potato Traders Gross Margins by County**




| | Bungoma | Uasin Gishu | Nakuru | Kisii | Kisumu | Meru |
|---|---|---|---|---|---|---|
| Irish Potato Gross Margin Analysis % Margin | 31 | 47 | 20 | 29 | 35 | 33 |

*Source: USAID Kenya Agricultural Value Chain Enterprises (USAID-KAVES), 2013*

We use the January 2014 RRA surveys conducted across major potato wholesale markets in Nairobi, Mombasa and Nakuru to further analyze the aforementioned results. Data collected included supply sources, main supply months, purchase price at sources, cost of operation, and average volumes traded. We develop rough estimates of the prevailing market practices. The results are contained in Table 17, and show that the average potato bag weighs about 150 kg, ranging from 135 to 160 kg. Traders report prices per bag but, due to lack of weight standards, a bag could be anything from 110 kg to 180 kg. Furthermore, although the source purchase prices reported included broker fees/commission, traders did not reveal how much they were paying per bag. Using various sources, including validations by USAID-KAVES field staff, we estimate the average broker fee at KSh700 per bag. These charges vary by production area and potato supply – high-production regions attract lower broker fees. They range from KSh500 in Meru to KSh1000 in Bomet/Kericho.

The broker commission contributed 24 percent to the total cost of landing a bag of potatoes at wholesale markets and a mark-up of 44 percent over the farm gate price. Table 18 contains the cost breakdowns in a landed bag of potatoes across markets. Accounting for operational costs (approx. KSh75 per bag), the broker earns an equivalent of 27 percent margin (KSh625 per bag). For every truck filled with potatoes (about 40 bags), the broker's profit is approximately KSh25,000 (US$294). This is realized for four-day work, which is much higher than the producers' average total net income per acre ($282) over four months (see Table ). With about five orders every month, the broker could be netting nearly US$1,470 per month for about four months of high supply per year (approx. $6,000 total).

**Broker Profit Margins**
With about five orders every month, a broker could be netting nearly US$1,470 per month for about four months of high supply per year (approx. $6,000 total)

After taking delivery of potatoes from brokers, wholesale traders incur additional costs of transportation, loading and unloading, market levies and sales commission. These amount to KSh651 per bag (approx. 28 percent on top of the cost of potatoes), with transportation alone accounting for 18 percent of total cost of potatoes at the wholesale markets. The other significant cost is the commission paid to market brokers (salesmen) amounting to KSh55 per bag. Overall, the purchase price constitutes 78 percent of the total wholesale landed cost per bag. **From the farm gate to the market gate, therefore, the price of a bag of potatoes rises by 85 percent, on average**; from producer price of KSh11.70 and purchase price of KSh15.20 per kg, the wholesaler lands the potatoes in the market at KSh19.54 and sells at KSh23 per kg.

**Table 17: Estimated Potato Wholesale Gross Margins**

| Market | Wakulima | | Kawangware | Kangemi | Kongowea | | Bomet | Nakuru | Average | % Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| Type | Red | White | Shangi | Shangi | Red | Shangi | Shangi | Shangi | | |
| *Source County* | Meru, Molo | Olkalau, Narok, Kinangop | Narok, Dundori | Timboroa, Kinangop, Kiambu | Molo | Meru, Molo | Bomet, Kericho | Mau | | |
| *Main supply month* | August | September | June-January | Augut-Feb | Ramadhan | All Year | | Jun-Jul | | |
| *Average weight of bag* | 135 | 160 | 135 | 150 | 150 | 150 | 160 | 160 | 150 | |
| Producer Price | 1,440 | 1,650 | 1,638 | 1,650 | 1,200 | 1,500 | 2,000 | 1,560 | 1,580 | |
| Local Broker | 750 | 800 | 550 | 650 | 650 | 650 | 1000 | 550 | 700 | 24% |
| Purchase price | 2,190 | 2,450 | 2,188 | 2,300 | 1,850 | 2,150 | 3,000 | 2,110 | 2,280 | 78% |
| Transport | 500 | 500 | 450 | 350 | 700 | 700 | 700 | 300 | 525 | 18% |
| Offloading | 20 | 20 | 20 | 20 | 50 | 50 | 30 | 40 | 31 | 1% |
| Levies | 30 | 30 | 30 | 50 | 50 | 50 | 30 | 50 | 40 | 1% |
| Market Broker | 50 | 50 | 40 | 0 | 100 | 100 | 50 | 50 | 55 | 2% |
| Total cost | 2,790 | 3,050 | 2,728 | 2,720 | 2,750 | 3,050 | 3,810 | 2,550 | 2,931 | |
| Cost per kg | 20.67 | 19.06 | 20.20 | 18.13 | 18.33 | 20.33 | 23.81 | 15.94 | 20 | |
| Losses | 135.00 | 135.00 | 81.02 | 76.67 | 246.67 | 286.67 | 187.50 | 131.88 | 160 | 7% |
| Producer price/kg | 10.67 | 12.22 | 12.13 | 12.22 | 8.89 | 11.11 | 14.81 | 11.56 | 11.70 | |
| Purchase price/kg | 16.22 | 15.31 | 16.20 | 15.33 | 12.33 | 14.33 | 18.75 | 13.19 | 15 | |
| W/sale price/bag | 3,150 | 3,400 | 3,250 | 3,300 | 3,500 | 3,500 | 4,200 | 3,300 | 3,450 | |
| W/sale price/kg | 23.33 | 21.25 | 24.07 | 22.00 | 23.33 | 23.33 | 26.25 | 20.63 | 23 | |
| GM per bag | 360 | 350 | 523 | 580 | 750 | 450 | 390 | 750 | 519 | |
| Net Margin/bag | 225 | 215 | 441 | 503 | 503 | 163 | 203 | 618 | 359 | |
| GM per lorry | 14,400 | 14,000 | 20,900 | 23,200 | 30,000 | 18,000 | 15,600 | 30,000 | 20,763 | |
| Net Margin per lorry | 9,000 | 8,600 | 17,659 | 20,133 | 20,133 | 6,533 | 8,100 | 24,725 | 14,361 | |
| GM % | 11% | 10% | 16% | 18% | 21% | 13% | 9% | 23% | 15% (10%) | |

*Source: USAID-KAVES Wholesale Market Surveys, January 2014*

**Table 18: Item Cost Breakdown in the Landed Cost of a Bag of Potatoes**

| | Wakulima (Two types reported) | | Kawangware | Kangemi | Kongowea | | Bomet | Nakuru |
|---|---|---|---|---|---|---|---|---|
| Local Broker | 27% | 26% | 20% | 24% | 24% | 21% | 26% | 22% |
| Purchase price | 78% | 80% | 80% | 85% | 67% | 70% | 79% | 83% |
| Transport | 18% | 16% | 16% | 13% | 25% | 23% | 18% | 12% |
| Offloading | 1% | 1% | 1% | 1% | 2% | 2% | 1% | 2% |
| Levies | 1% | 1% | 1% | 2% | 2% | 2% | 1% | 2% |
| Market Broker | 2% | 2% | 1% | 0% | 4% | 3% | 1% | 2% |

*Source: USAID-KAVES calculations from Wholesale Market Surveys 2013 data*

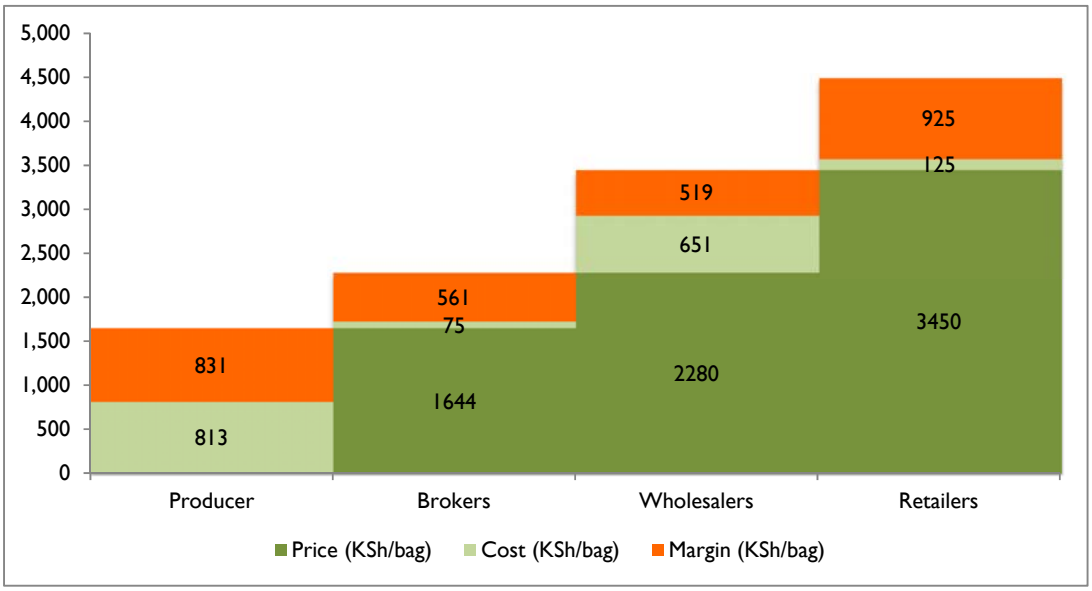
The wholesaler thus realizes a margin of KSh519 per bag, equivalent to 15 percent margin (or 10 percent if the cost of potato losses – 7 percent per bag, is included). For every lorry-load (40-60 bags), therefore, the wholesaler's average net income is KSh20,763 (US$244) over 4-5 days. Assuming five lorry round trips every month, and about five months of active trading per year, the wholesale trader can earn up to US$1,200 per month and $6,000 per year.

By current Kenyan standards, brokers and wholesale traders are doing very well from potatoes business. For producers and retailers, the picture is not too appealing. Retailers earn a lot per unit but gross very little due to small volumes. They can earn up to KSh1,200 ($14) per week – KSh675 over the 3-4 days it takes them to clear a bag of stock, and approximately $225 over four months, which is lower than the producers' average earnings over an entire cropping cycle.

**Trader Profit Margins**
Assuming five lorry round trips per year, the wholesale trader can earn up to $1,200 per month and $6,000 per year.

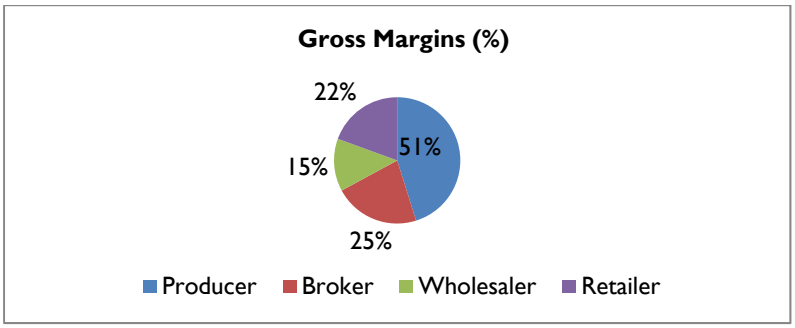
Combining all the producer budgets and gross margins, wholesaler operational costs and margins, we present the overall results in Figure 15, showing the distribution of gross margins among the major value chain actors. This Figure uses the average of the three producer crop budgets discussed to arrive at producer cost and the wholesale markets averages to estimate prices and margins.

**Figure 15: Gross Margins Earned by Value Chain Actors (KSh per bag)**



The results (Figure 16) find producers earn the highest margins on their potatoes, at 51 percent, which are twice those of brokers and more than three times of wholesalers. As explained before, however, we believe that wholesalers and retailers earn higher "hidden" margins from potato weight and baggage manipulation. Considering the magnitude and duration of investment, the producer margins are the lowest among the value chain actors. For example, while producers earn 51percent from 120 days of work, brokers earn their 25 percent from about four days of work and wholesalers about one week.

**Figure 16: Gross Margins Earned by Value Chain Actors (per bag)**




*Source: USAID-KAVES Estimates from Baseline Survey, 2013 & Markets RRA, 2014*

## 5.4 SUMMARY OF FINDINGS

From the margins analysis results, Table 19 summarizes the earnings of each value chain actor for over four months in the potato crop cycle. Despite the high margin, the magnitude and duration of investment make the producer's income the second lowest among the value chain actors. Farm households earn an equivalent of KSh5,194 ($61) per month from potatoes, or KSh20,775 ($244) per crop cycle. In comparison, over the same period, a broker could earn approx. KSh337,000 ($3,960) and a wholesale could earn KSh415,200 ($4,885).

**Table 19: Estimated Earnings from Potato Enterprises per Crop Cycle**

| Actors | Gross margin (KSh per bag) | Volumes | Months of operation | Income |
|---|---|---|---|---|
| Producers | 831 | 41 bags per acre (25 bags on average plot – 0.6 acre) | 4 | KSh20,775 ($244) |
| Brokers | 561 | 40 bag lorries, five lorries per month | 3 | KSh337,000 ($3,960) |
| Wholesalers | 519 | 40-60 bags lorry, four trips per month | 4 | KSh415,200 ($4,885) |
| Retailers | 925 | five bags per month | 4 | KSh18,500 ($218) |

*Source: USAID-KAVES estimates*

Returns from yield and production enhancing interventions at the farm level might diminish even further without concomitant improvements in marketing. Higher production only means local brokers will gain more leverage over producer prices. Promoting better storage practices appears more viable but most smallholder farmers have little incentive to store potatoes for market for the reasons alluded to in this report, including liquidity constraints at harvest and very short cropping cycles. Based on the analysis, the key areas to intervene to improve producer returns in the potato sector should focus on reduction of costs of fertilizers, chemicals and labor. **Efforts should be made to support farm-level selection and multiplication of seed as a way of reducing cost. Improvement of production technologies, in form of use of quality seed and integrated pest management will also lead to higher profits for the small-scale producer.**

# 6 BUSINESS ENABLING ENVIRONMENT

## 6.1 SUPPORTING ORGANIZATIONS & INSTITUTIONAL ACTORS

Kenya has several ministries handling agriculture-related issues, including the State Departments of Agriculture, Livestock, Lands, Environment and Mineral Resources, and Devolution and National Planning, among others. The Agricultural Sector Coordination Unit (ASCU) and the National Stakeholder Forum play a crucial inter-ministerial role in formulating agricultural policies in consultation with various stakeholders. The Ministry of Agriculture provides extension services and leadership in formulating policy, legal and regulatory framework. It also generates market information through the Agricultural Information Resource Center (AIRC).

### 6.1.1 Implementing Institutions

Kenya's institutions, especially producers' and traders' associations and public institutions, are not adequately developed to provide effective support to the potato value chain. Where they are well established, producers' associations are important in disseminating market information, providing extension services and credit, generating economies of scales in marketing, and enhancing the bargaining power of producers. However, producers' associations currently lack the capacity to fulfill these roles. Traders' associations are virtually nonexistent and trading through the potato value chain is generally disorganized and captured by numerous informal brokers. Public regulatory institutions are weak because of limited resources (financial, infrastructure, and human). Their ability to regulate and enforce marketing and quality standards is limited. The legal institutions regulating rural commerce are particularly weak and thus make for less efficient markets. With so many powerful brokers along the value chain, formal market organization and contract enforcement is near impossible and hence marketing innovation remains depressed.

***Horticultural Crops Development Authority (HCDA)*** is a Parastatal (State Corporation) established under the Agricultural Act Cap 318 and Legal Notice No. 229 of 1967. The strengths of the Authority include the existence of horticultural produce handling facilities; advanced information resources; well-trained and competent staff; improved countrywide presence; and, implementation and adoption of quality management systems according to ISO 9001:2008. Its challenges include:

- Multiplicity of legal instruments and regulations;
- Lack of human resource capacity to deal with rapidly changing dynamics, especially in a rapidly expanding domestic market, and challenges in mounting effective presence in the counties and in global markets;
- Inadequate technical capacity to provide services to a wide range of value chain actors (large as opposed to smallholders);
- Inadequate resources and high input costs that tend to encourage high levies (according to industry players) which are not commensurate with the level of provision of regulatory and technical services, such as value addition, training and market information;
- Ineffective communication framework and ICT facilities;
- Underutilization of infrastructure, such as produce handling (e.g. cold storage) facilities;
- Ineffective M&E mechanisms;
- Conflict of interest leading to operational discordance in the industry (public sector as opposed to private sector).

***Kenya Plant Health Inspectorate Services (KEPHIS)*** was established through the Legal Notice No. 305 of 18th October 1996 pursuant to the State Corporations Act Cap 446 to undertake quality control services of agricultural inputs, plant variety protection and plant health. The strengths of KEPHIS include: Local and internationally recognized accreditation and certification; availability of infrastructure; good corporate governance; competent and committed staff; international recognition

and membership to international organizations; advanced laboratories and inspection services; decentralized services for ease of access; enhanced collaboration with all stakeholders; and an ability to form and maintain linkages with collaborators and donors. Weaknesses include: limited resources; lack of specialized capacity in specific disciplines; inadequate visibility and awareness about some institutional services; inadequate procedures for implementation of existing legal framework; inadequate internal legal capacity; and weaknesses in succession planning.

***Pest Control Products Board (PCPB)*** was established in 1985 under the Pest Control Products Act (Cap 346). Its functions are to regulate the importation, exportation, manufacturing, distribution and usage of pesticides. Broadly, the Board derives its strength from internal resources and capabilities that enable it to accomplish its mandate and achieve the strategic objectives. The specific strengths include: Good collaboration with public and private organizations, academia, and with the government extension service providers; nationally, regionally and internationally recognized standards; a state of the art operational and well maintained website and database accessible to the public for information and awareness creation; internal quality control analytical laboratory; an enabling legal framework with trained prosecutors, and highly technical and competent staff The main weaknesses identified were: limited capacity to conduct post registration verification tests, monitor cross border trade, ensure that pesticides are used for recommended and registered uses; low capacity for assessment and evaluation of products and enforcing compliance with ratified international conventions; and, limited physical facilities and resources including office space, human resources, technological and ICT infrastructure.

***Horticulture Competent Authority Coordinating Committee*:** The MOA established the Horticulture Competent Authority Coordinating Committee in November 2011.[14] The Committee is a mechanism for streamlining enforcement of sanitary and phytosanitary measures that were adversely affecting the horticulture industry, especially the concerns with rejection of Kenyan produce in the international market. The committee meets on an as needed basis and as frequently as once a month when tackling urgent issues. The Committee was recently audited by FVO, which assessed, among other things: the structure of the Committee and roles of the constituent institutions; nature of training horticulture producers receive and whether some of them still use prohibited chemicals (such as dimethoate); the capacity of the KEPHIS labs to detect residues at prescribed levels; mechanisms for institutionalizing traceability in the industry; and, whether or not the proposed reforms under AFFA will compromise the functions of the Committee. The final audit report has not been released but discussions with KARI indicate that the Committee is moving in the right direction.

***National Food Safety Coordination Committee (NFSCC)*** is a multi-sectoral committee initiated by various government agencies/institutions. It is responsible for coordinating all food safety activities in the country.[15] It was established in response to stiffer penalties/regulations on food specifications and codes set by importing countries such as the European Union (e.g. EuroGap and EU directive 91/493/EEC). It seeks to increase awareness about the impact of food safety and quality, and to initiate the revision and harmonization of all the relevant Acts of Parliament. It is aimed at ensuring that food produced, distributed, marketed and consumed meets the standards of food safety.

[14] The committee comprises KEPHIS (to serve as the central notification point and chair of the technical committee in addition to core competence on all matters phytosanitary and residue testing); PCPB (responsible for testing, registration and regulation of plant protection products); HCDA (to undertake registration and development of the horticulture sub-sector); KARI (to undertake all research issues in horticulture); FPEAK (dealing with fruits and vegetable exports); and KFC (dealing with export of flowers).

[15] The Members are the Department of Veterinary Services, Department of Livestock Production, Department of Fisheries, Kenya Bureau of Standards, Kenya Plant Health Inspectorate Services (KEPHIS), National Public Health Laboratory Services (NPHLS), Government Chemist, Kenya Medical Research Institute (KEMRI), University of Nairobi, Tea Board of Kenya, Coffee Board of Kenya, Kenya Agricultural Research Institute (KARI), Kenya Dairy Board, Pest Control Products Board, Ministry of Local Government, and the National Biosafety Authority (NBA). Co-opted members include World Health Organization (WHO), Food and Agricultural Organization of the United Nations (FAO), and UNIDO.

### 6.1.2 Private Sector Associations

**Fresh Produce Exporters of Kenya (FPEAK)** was established in 1975 as a limited company. The association is a recognized partner in all the leading agricultural legislation consultation, certification and research bodies, and development partners in Kenya. This makes it possible to influence innovation and policy to the benefit of its members and the industry at large. It has a mission "to develop, unite and promote the Kenyan horticultural industry in the global market with due regard to safety, good agricultural practices, social, ethical and environmental responsibilities" (FPEAK, 2014). Its strategic goals are to: update and implement Kenya Gap to recognized international standards; influence enactment of a facilitative environment for the horticulture industry; create awareness in the horticulture industry on market requirements, changes and regulations; and, undertake continuous identification of market opportunities. Other activities include: provision of timely information on technical issues, trade, official regulations, and market requirements; undertaking trade enquiries from overseas buyers; conducting training programs in conjunction with specialized trainers; undertaking pre-certification appraisals; supporting small scale farmers through training programs targeted at good agricultural practices; market development through coordinating the participation in trade events of its members; and, undertaking advocacy and lobbying through continuous monitoring of domestic and international policy.

**Horticulture Council of Africa (HCA)** is a network established by major horticulture exporting countries in the Eastern, Central and Southern Africa (ECSA) region.[16] HCA aims to bring greater bargaining power to address common challenges and constraints, such as competition and compliance with safety and standards that these countries face, especially in the European markets. It is also active in organizing sharing of information and technical skills, as well as providing a common platform for negotiations on economic partnership agreements (EPAs) and at the WTO.

The HCA aims at complementing rather than competing with national horticulture associations, such as FPEAK and KFC in Kenya, Rwanda Flower Producers and Exporters Federation, Horticultural Exporters Association of Uganda, and Horticultural Promotion Organization of Uganda (HPOU). This, however, is easier said than done as in practice, the member countries must compete in the emerging regional markets. The fact that Kenya, for example, is concerned about increasing horticulture imports from neighboring countries like Tanzania and Uganda, means that HCA would have to play more proactive and regulatory roles for which it is ill suited, especially considering its limited human capacity.

Other key industry players that have synergies with the horticulture value chains and/or promote horticultural products commercialization, marketing and technology support include The Kenya National Chamber of Commerce and Industry; The Kenya Association of Manufacturers (KAM); and, East African Business Council (EABC)

### 6.1.2 Research, Extension, and Information Institutions

Kenya has several public and donor-funded national and multinational research programs, including:

- *Kenya Agriculture Research Institute (KARI) – Tigoni*. Responsible for research and breeding
- *Local universities, especially Egerton University, the University of Nairobi, and JKUAT* – research on potato breeding and crop protection, agronomic practices, socioeconomic studies, and training in farm management.
- *International Potato Center (CIP)* – potato germplasm, production systems, policy and value chain analysis.
- *National Agricultural Research Laboratories (NARL)* – national mandate and responsibility for agriculturally related research in Natural Resource Management
- *Private agribusiness companies*, including regional centers for multinationals and seed potato multipliers.

[16] Member countries include Kenya, Uganda, Zambia, Tanzania, Zimbabwe, South Africa, Burundi, Rwanda, and Ethiopia.

Potato research is a public sector undertaking done at KARI-Tigoni, in collaboration with CIP, local universities, agro-chemical companies, processors, producers and Kenya Plant Health Inspectorate Services (KEPHIS). KARI has the national mandate to carry out research on all aspects of the potato crop and circulate recommended breeders' seed to seed growers for further multiplication. KARI has potato research programs in agronomy, breeding, crop protection, food processing and post harvest technology, pest and disease control, seed research (including development of sustainable seed systems), socio-economics and Technology transfer Variety release has concentrated on developing varieties that are tolerant to diseases while also having acceptable cooking qualities. Potato breeding research has not paid due attention to processing attributes despite processing companies complaining about high wastage and poor quality products from the commonly available varieties. The Dutch Robijn variety from Bomet county is better than other available varieties despite being low yielding and highly susceptible to diseases, especially late blight. . Bacterial wilt research is carried out at NARL.

The CIP has produced a five-year roadmap strategy that targets business investments in key areas along the seed potato value chain. The goal of the strategy is to increase the availability of high-quality seed potatoes from less than 1 percent to at least 10 percent of demand and promote improved seed management (Schuller, 2013). CIP is also designing a potato seed master plan, which the Kenya government has promised to adopt. It has already conducted an extensive seed market survey, gathering information on seed demand and availability from over 1,300 growers from all the major potato-production districts in Kenya, and is working with both private and public sector partners to introduce the new aeroponics technology that produces substantially higher numbers of potato seed, in the form of the mini-tubers. In close collaboration with KARI, CIP is also working to test and release varieties of potatoes for smallholder producers that are resistant to late blight, the most serious disease threatening potatoes worldwide.

The Regional Potato and Sweet Potato Improvement Network in Eastern and Central Africa (PRAPACE) currently collaborates with potato and sweet potato programs in 10 countries (Burundi, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania and Uganda), as well as all members of the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA.). In Kenya, CIP provides support to the network in the forms of improved germplasm, scientific information, training, and administrative assistance and USAID funds the network.

### 6.1.3 Financial Service Providers

Providers of finance, accounting and business development skills, insurance, quality testing/certification, and research and extension play a critical role in the development of the potato value chain. Linkages to these providers and the capacity to engage with them is lacking for most of the smallholders in USAID-KAVES target counties.

**Finance and credit**: There are no credit facilities specifically targeting potato producers but there are facilities targeting producers in general that have benefitted potato producers. Some have been through collaborative efforts (like Njaa Marufuko,), through access to farming bank loans (Kenya Commercial Bank, Cooperative Bank), or through microfinance institutions and the private sector. There are also a number of microfinance institutions and savings and credit cooperative societies (SACCOs), banks, insurance companies, public and research institutions providing various support services to producers and other value chain actors. For example, the Program for Rural Outreach of Financial Innovations and Technologies (PROFIT), funded by IFAD, aims to deepen financial access to small-scale producers. The facility has two main components, rural financial outreach (risk sharing, credit facility and innovation facility) and technical assistance (business support services and financial graduation). Currently the loan facilities are available through the following participating financial banks (Barclays, Cooperative, K-Rep and AFC) and deposit taking microfinance institutions (KWFT, FAULU, Rafiki, and SMEP). However, knowledge about the existence of these service providers among small-scale producers remains limited.

As a response to challenges of service provision, the IFDC has initiated the 2SCALE project that seeks to develop agribusiness clusters (ABCs) to offer producers market and credit linkages. It has established

potato clusters in Meru to bring together a range of partners to ensure that all requirements (market, seeds, fertilizer, extension, credit) are in place for potato producers (see Box on page 68).

## 6.2 REGULATORY AND POLICY ENVIRONMENT

### 6.2.1 Legal and Regulatory Framework

*The **Agriculture, Fisheries and Food Authority (AFFA) Act** of 2013* is intended to give effect to the 4th Schedule of the Constitution of Kenya (the distribution of functions between the national government and the county governments) and the creation of a central authority, AFFA, to consolidate all laws regulating and promoting agriculture. The functions of the Horticulture Crops Development Authority (HCDA) will be discharged within AFFA. A company registered under the Companies Act will undertake commercial functions; AFFA will perform non-commercial functions. This proposal has elicited major concerns among industry players, who when interviewed, worried that delinking the highly complementary functions of the HCDA, the Pest Control Products Board (PCPB) and the Kenya Plant Health Inspectorate Services (KEPHIS) could lead to bureaucracies that would stifle horticulture development. The Act also provides for creation of Directorates within the Authority for each produce to undertake any specialized activities with respect to promotion and management of the commodity.

## Potatoes for Profit in Kenya

The first 2SCALE agribusiness clusters (ABCs) in East Africa were launched in December 2012. producers in Kenya's Meru County are establishing three clusters to grow high-quality potatoes to sell to a Nairobi-based processor. The clusters, comprised of over 800 producers in Kibirichia, Timau and Kisima, received technical backup and initial funding from the project and were expected to become financially independent by December 2013. A business support team works closely with the producers to provide training and year-round monitoring of crop management, marketing and agribusiness management. producer training on fertilizer top-dressing, pesticide use, accounting and financial management is also undertaken.

2SCALE has brought together a range of partners to ensure that all requirements (market, seeds, fertilizer, extension, credit) are in place. The partners include: Equity Bank; the Syngenta Foundation for Sustainable Agriculture (SFSA), which will provide crop insurance; training and extension experts; and seed, fertilizer and agrochemical suppliers.

The project seeks to double current yields (12 t/ha) through improved production methods and increase incomes by one-third by linking producers directly to an assured market. It will promote new varieties, fertilizer use and improved crop management, and stabilize farm-gate prices by building storage facilities and linking producers to buyers. Most producers, for example, use less than one-third of the recommended fertilizer rates because of input shortages and market uncertainties. More training is needed on agronomy, harvest methods (many producers harvest their potatoes too early) and safe use of crop protection products. A key issue is the best method to establish a rotation system, with a staggered planting cycle to ensure a steady supply of potatoes throughout the year. The discussions highlighted several other issues – bank loans, payment and tonnage commitments and storage capacities on-farm and at Sparta. Forming an ABC can overcome many of the problems faced by producers. A cluster can provide producers a stable market and fairer prices, allow producers to share transport, agro-input and other costs, and more easily access credit and information. An ABC also guarantees the buyer reliable, high-quality supplies year round.

Driving the development of the Meru clusters is the 'business champion' – *Sparta Foods Ltd*., a Nairobi-based firm that processes and sells whole, peeled and sliced potatoes to hotels and restaurants. Sparta plans to triple its capacity to 450 MT per month by 2014, and to progressively contract with as many as 4,000 to 5,000 producers in the next five years. "Our main problem is supply," explained Audrey Ndubi, managing director of Sparta. "We currently import potatoes from Tanzania when supplies from Kenyan producers are not adequate. These three clusters will help keep our processing plant running at full capacity throughout the year."

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*http://www.ifdc.org/Projects/Current2/East_Southern_Africa_Division/2SCALE_Toward_Sustainable_Clusters_in_Agribusiness/2SCALE_Articles/Potatoes-for-Profit-in-Kenya/*

*The **Crops Act** of 2013* has been enacted to consolidate and repeal various statutes in order to facilitate the growth and development of agricultural crops. The Act provides for the role of national and county governments in the development of crops. It also provides for incentives to Producers, guiding principles in the management and administration of agricultural land, registration requirements for scheduled crops, and licensing and taxation provisions. Operationalizing the Act under a devolved system faces numerous challenges, chief among them being resistance over the restructuring of institutions and human capacity constraints.

*The **Kenya Agricultural Research Act** of 2013* has been enacted to provide for the establishment and articulation of the functions of the Kenya Agricultural and Livestock Research Organization (KALRO), and the coordination of agricultural research activities.

Other notable potato legal and regulatory reforms include: Legal Notice No. 44 (local government by-law 113), the crop production and livestock (seed and ware potato production and marketing standards) rules of 2005; and the Seed Potato Master Plan (2010). In addition, Legal Notice No. 113 provides the maximum weight for a bag of potato for sale as 110 kg, Ministry of Local Government (Adoptive by-laws) (Agricultural Produce) (Standard Weight of Packages) Order of 2008.

**In spite of this regulatory framework, aimed at improving transparency along the value chain and generating better returns for producers, enforcement remains weak due to lack of standards and appropriate institutionalization of the laws** (MOA, 2012). For example, traders have largely disregarded the regulation on standard bag size and other marketing matters, with bag sizes getting as large as 260 kg during period of oversupply.[17] This is a result of uncoordinated adoption and enforcement across the country and a lack of harmonization with the preferences of key potato markets. Where local governments, such as Meru, have adopted and enforced bag sizes, traders buy potatoes in the standard flat bags, transship them to locations outside the districts jurisdiction, like Nanyuki, then unpack the bags and repack into 130 kg extended bags. The latter remains the preferred packaging for Nairobi wholesale markets. The law also requires potatoes to be packed in sisal or jute bags that are well ventilated with netting at the top to allow for inspection of the produce. The most common practice, however, is to pack potatoes in the cheaper, more readily available polythene bags with netting at the top.

### 6.2.2 Policy Regime

The policy regime in Kenya consists of support functions for the national government and the regulatory and facilitating functions of the new county governments. At the national level, policy reforms and interventions relevant to horticulture industry and potato sector include the following: Agricultural Sector Development Strategy (ASDS), 2010-2020; National Agricultural Sector Extension Policy (NASEP), 2012, National Horticulture Policy, 2012; National Agricultural Research System Policy, 2012; National Agribusiness Strategy, 2012; and the National Seed Policy, 2011. A review of these policies is covered in more details in the USAID-KAVES Maize Value Chain report (2014).

The National Potato Council of Kenya (NPCK) was recently formed with a mandate to formulate a new policy to guide the growth of the industry. It is currently developing a National Potato Policy, and has established a potato task force to prepare a report to feed into the process (Janssens et. al., 2013).

### 6.2.3 Devolution of Agricultural Policies

Emerging county agriculture policies and regulations will significantly reshape Kenya's agricultural policy regime.[18] The emergence of these devolved units will change the organization of local agricultural sectors, particularly in the areas of extension and education, inputs marketing policies, and production support strategies. County government policies/strategies, institutions, levies and taxes, priority value

[17] Muthoni et al. (2013) found an extended bag of potatoes weighing 183 kg.

[18] Five Acts and Bills on devolution related to agriculture are pending before Parliament. They include: (a) Agriculture, Fisheries and Food Authority (AFFA) Act (No. 13 of 2013) that commenced on 25th January 2013; (b) Kenya Agricultural and Livestock Research Act (No 17 of 2013); (c) Pyrethrum Act (No. 22 of 2012); (d) Crops Act (No. 16 of 2013); and, (e) The Kenya Plant Health Inspectorate Service Bill, 201. All these laws remain contentious and currently under review.

chains and facilitation of value chain actors must be understood within the broad legal framework established to support county governments.

Of specific importance will be production and marketing levies already being proposed across the country. The impact of these policies will vary depending on whether a county is a net producer or net consumer of potatoes. There is a growing concern among traders and agricultural officers that the charges are higher than the margins generated from commodity sales. The following items will be particularly important for USAID-KAVES interventions in the potato value chain: 1) Storage/rental fees and charges; 2) Transportation charges; 3) production and trade cess; 4) Roadblocks and weighbridges.

Concerns have also been raised about the potential influence of devolution on the horticulture industry with respect to County government policies/strategies, regulations, and institutions, and concurrence of county priorities and goals with those of the central government. A number of functions formerly in the domain of the Ministries or state corporations have now been devolved per the constitution. In practice, however, confusion reins about the impact of some policy reforms (such as Agriculture, Fisheries and Food Authority - AFFA), and their implementation and coordination arrangements.[19]

### 6.2.4 Price Control and Taxation

Three recent legislations have direct bearing on the potato value chain, namely: 1) The Price Control (Essential Goods) Act No. 26 of 2011; the Consumer Protection Act of 2012; and, the Value Added Tax Act of 2013 (CAP 476). The Price Control Act aims to provide regulation of the prices of essential commodities in order to secure their availability at reasonable prices. However, the list of prices for the essential commodities was never announced. In addition, the Consumer Protection Act provides for punishment of businesses that knowingly sell sub-standard goods, lie on pricing, and use misleading information to sell goods and services. With outstanding issues of quality and market malpractices, these two statutes are particularly relevant to seed and ware potato production and marketing.

Under the new Value Added Tax Act, the supply or importation of potatoes, seed, and agricultural services are classified as exempt from tax. Reclassifying agricultural services and inputs as exempt makes them more expensive overall. Maina (2013) analyzes the differences between exempt and zero-rated status, and concludes that the difference in the price of exempted supplies remains the same as those charged 16 percent VAT. This is a result of the fact that businesses supplying exempted goods/services have no mechanism to claim back input VAT, which then must be converted into a cost, while those under the 16 percent VAT category do.

The single most important threat to the potato value chain is the increased cost of other services, such as transportation and distribution, which are not exempt. The 16 percent VAT on distribution will increase the cost of production inputs, transportation costs, and ultimately milk prices. The potato industry is heavily dependent on transportation and distribution services, which will most likely suffer higher costs of operation and shift the burden to producers and consumers. Since the cost of transport currently constitutes 20 percent of the total cost of landing potatoes at wholesale markets, marketing costs are likely to rise and will be transferred to consumers in the form of higher prices.

[19] Information on the implementation and coordination arrangements under the devolution policy, based on rapid appraisal surveys, is included in the USAID-KAVES Maize Value Chain report (2014)

### 6.2.5 Trade Policy

**Tariff Reduction:** The East African Community Customs Union (EAC/CU) was officially launched in July 2009 to increase competition, expand markets, ease cross border trade through harmonization of national trade policies, and enhance trade by removal of tariff and non-tariff barriers (NTBs). Imports from the East African Community (EAC) are free of duty and subject only to regulatory fees and levies according to the respective trade protocols. The impact of the EAC/CU on trade in horticulture and potatoes may be negligible because regional trade in most agricultural products was already zero-rated under EAC and COMESA protocols.

**The following regulations govern regional cross border trade (MOA, 2012):**

- *Import duty*: goods from EAC member states are exempted from import duties. However, non-EAC produce is charged common external tariffs (CET) at 0 percent for capital and raw materials; 10 percent for intermediate goods; and 25 percent for finished products.
- *Import Declaration Form (IDF)*: is pegged at 2.75 percent of the value of all imported products.
- *Certificate of Origin* to show the commodity is from the EAC to qualify for tax exemption.
- *Certificate of Conformity (CoC):* applicable for commodities from outside the EAC.
- *Export permit issued by HCDA after inspection*: KSh2 per kg of commodity being exported.
- *Import Permit and Phytosanitary Certificate* issued by KEPHIS after inspection of commodity and verification of inspection documents from country of origin. This certificate costs KSh1000.
- *Packing list* to identify the commodity and actual quantity being imported or exported.
- *Plant import permit* for plant products costs KSh600 per consignment.

**Technical Barriers to Trade (TBT):** With the steady elimination of tariffs, technical requirements are increasingly becoming the biggest impediment to trade in agricultural products. This includes sanitary and phytosanitary measures (SPS) and standards. To address these emerging concerns, under Article 81 of the EAC Treaty, the Partner States recognized the importance of standardization, quality assurance, metrology and testing for the promotion of trade and investment and consumer protection. The EAC partner states enacted the East African Standardization, Quality Assurance, Metrology and Test Act 2006 (EAC SQMT Act 2006) to harmonize requirements on quality of products and services and reduce trade barriers. The SQMT Act regulates trade in products produced or originating in a third country to facilitate industrial development and trade as well as promote health and safety and environmental protection.

**Non-Tariff Barriers (NTBs):** However, despite numerous efforts by the EAC and COMESA to free regional trade, non-tariff barriers (NTBs) and other administrative charges continue to hinder formal trade among the member countries. Whereas the above constitute mandatory transparent trade facilitating measures, their administration often lead to costly delays, duplication of effort, lack of inclusiveness in their enforcement, low capacity in the mandated institutions, and lack of transparency and accountability that tends to promote corruption and partiality. The NTBs also comprise a wide range of trade policy practices applied by governments, whose main aim is usually to restrict trade flows in order to achieve specific objectives, such as the protection of infant industry, reduction in domestic supply of a staple foodstuff such as maize, or consumer protection. NTBs can arise from unofficial actions of public officials (due to inefficiency or corruption in administration of customs duties), from the state of technology (e.g. inability to innovate in terms of telecommunication and management and information systems), or simply due to poor roads and marketing infrastructure.

To address NTBs, EAC partner states have agreed on the following:

- Facilitation of trade by simplifying, standardizing and harmonizing trade documentation.
- Establishment of anti-dumping measures elaborated in the EAC/CU Protocol.
- Implementation of competition law and policy to deter trade-distorting practices.
- Exemption of re-exports from the payment of import or export duties.
- Agreement to remove all existing NTBs and limit the introduction of new NTBs, under Article 13 of the EAC/CU.

## 6.3 INFRASTRUCTURE

The infrastructure needed for potato value addition includes energy, transport, irrigation water, storage facilities, communications, and physical bulking and cooling plants. By virtue of its bulkiness and high perishability, storage and transport infrastructure, including cooling (refrigeration), roads, and rail facilities, are major price and quality determinants in the potato industry. Most smallholders are inadequately served by such facilities.

### 6.3.1 Transport Infrastructure

Potato production and marketing is heavily dependent on transport infrastructure, from the distribution of bulky inputs like fertilizers and seed to moving production output to markets. The condition of roads and the availability of transportation are key determinants of the structure and performance of the potato value chain, and are the leading factors sustaining the cartel-like behavior of informal village brokers and traders. Poor roads, for example, hinder vehicular movement and thus lower accessibility, increase potato losses and transportation costs, lead to higher input and service prices, and thus lower producer returns. Traders cannot access most rural producers during wet periods and therefore require them to deliver the produce either to the nearest all-weather roadsides or local markets. The additional cost of transport, together with depressed prices due to gluts in supply, significantly diminishes producer margins and can lead to substantial losses.

### 6.3.2 Electricity

Kenya does not generate enough electricity to meet demand, neither is the distribution of the available electricity efficient. Most rural areas are hardly covered and, where available, frequent power shortages and outages are the norm. Electricity is generally too expensive for most households and businesses. Without adequate and reliable power, potato storage and value addition investment opportunities will remain unexploited. In addition, unreliable electricity supply makes the storage and preservation of seeds more expensive and risky. Refrigerated) facilities are largely nonexistent, thus potatoes must be disposed of immediately to avoid losses through quality deterioration and spoilage.

### 6.3.3 Rural Market Facilities

Cold storage facilities are particularly critical for seed potato systems. The Agriculture Development Cooperation (ADC) Molo station has 19 potato cold stores with a total capacity of 100 metric tons. The facility was constructed in 1985 with the support of the Dutch government. In addition, the government has equipped potato tissue culture laboratories, constructed greenhouses for potato seed screening, and procured 700 acres of land in Molo for seed potato multiplication. Other government infrastructure includes a micro-propagation laboratory at KARI Tigoni. However, production of adequate quality seed and utilization of the storage facilities is well below potential, which is attributed to the lack of private sector involvement (MOA, 2012).

Overall, the poor state of storage facilities and roads contributes to high production costs, low sales prices, and high postharvest losses. The debate over the exact impact of rural accessibility on potato markets remains unresolved but is believed to be substantial, especially during the rainy season right at the peak of harvesting. The effect of remoteness could be more manifest in access to markets and traders. Since potatoes are bulky, transportation on poor roads exerts substantial costs and discourages private transporters from venturing into certain areas.

# 7 UPGRADING INTERVENTIONS

Potato has a significant potential for addressing food insecurity in Kenya due to its high productivity per unit area and a strong and growing market demand. However, under current conditions, the net return to smallholder growers is low and interventions should be focused on reducing the cost of production. Based on the information and analyses provided above, the table below presents three components for a KAVES intervention strategy to upgrade the performance of smallholders in the potato industry. The three components are supported by nine specific strategic interventions and 22 objectives that will increase on-farm productivity, streamline potato aggregation, and improve market systems for fresh and processed potato products. Interventions have been selected that will contribute directly to the goals and objectives of the KAVES project and are highly scalable through private sector partnerships, with varying levels of public sector support. The interventions all rely heavily on the mass adoption of new technologies, supported with specialist training and extension; new sources of investment and credit to unlock value chain constraints; and engagement of private sector partners for market development and sustainability.

| Recommended intervention | Specific upgrading objectives | Challenges | Outcomes |
|---|---|---|---|
| **Strategic intervention 1: Increase productivity** | | | |
| **1. Improve farmers access to high quality extension services** | 1. Farmers organized into producer and marketing groups<br>2. Trainers trained in potato agronomy and marketing<br>3. New technologies adopted | • Low capacity of county government extension services<br>• Limited capacity of buyers and suppliers to provide technical support | • Higher farm yields, productivity and income<br>• Trained extension workers in public and private sectors |
| **2. Increase range and availability of alternative varieties** | 4. Partnerships formed between distributors and groups with seed importers<br>5. New varieties demonstrated and adopted | • Inadequate supply of basic seed<br>• Inconsistent quality of seed<br>• Few suppliers | • Higher yields<br>• More local production of suitable potatoes for processing<br>• Longer production seasons |
| **3. Increase use of clean seed** | 6. Growers adopt small seed plot techniques and positive seed selection<br>7. Number of seed multiplication merchants increased<br>8. Use of diffused light stores scaled up | • Shortage of foundation seed<br>• Few certified seed suppliers<br>• Cost of seed stores | • Higher yields<br>• Less crop failure<br>• Less wastage |
| **4. Optimize use of organic and inorganic fertilizers** | 9. Fertilizer application techniques including foliar feeds demonstrated and adopted<br>10. Number of bio-fertilizer suppliers increased<br>11. Fertilizer available in smaller packages | • Perceived high cost of fertilizer<br>• Few rural suppliers of specialist inputs | • Increased yields<br>• Reduced cost of production<br>• Increased gross margins |

| | | | |
|---|---|---|---|
| **5. Train farmers on potato IPM techniques** | 12. Biological pesticides demonstrated and adopted<br>13. Availability of approved products increased in rural areas | • Lack of availability of specialized inputs<br>• Few trainers available | • Higher quality potatoes<br>• Less wastage<br>• Safer products<br>• Reduced pesticide costs |
| **Strategic intervention II: Reduce post-harvest losses** | | | |
| **6. Improve post-harvest handling and storage systems** | 14. Low cost on-farm storage facilities demonstrated and adopted<br>15. New collection centers established | • Cost of materials<br>• Shortage of trainers<br>• No premium for higher quality | • Increased marketable yield and incomes<br>• Less wastage<br>• Extended marketing period |
| **7. Introduce quality standards** | 16. More trainers available on grades and standards<br>17. Standards adopted by growers and buyers | • Inefficient transport and wholesale systems<br>• No price incentives for higher quality | • More reliable markets for farmers<br>• Less wastage |
| **Strategic intervention III: Raise levels of aggregation and processing for greater market access** | | | |
| **8. Carry out detailed market survey** | 18. Accurate market information available<br>19. Farmers growing varieties for specific markets | • No institutional capacity for market analysis<br>• Few reliable sources historical data | • Better understanding of market operations<br>• Identification of apparent market inefficiencies<br>• Disaggregation of demand for fresh and processed potato products<br>• Potential for import substitution assessed |
| **9. Promote collective marketing** | 20. Groups obtain new contracts and marketing agreements<br>21. Farmers access new markets<br>22. Greater aggregation of product to obtain commercial loads | • Low business capacity of farmer groups<br>• Inefficient wholesale systems | • Increased sales and higher returns<br>• Farmers have more bargaining power |

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# ANNEX II: LIST OF ACRONYMS

| | |
|---|---|
| AAK | Agrochemicals Association of Kenya |
| ADC | Agriculture Development Cooperation |
| ADSP | Agribusiness Development Support Project |
| AFFA | Agriculture, Fisheries and Food Authority |
| AIRC | Agricultural Information Resource Center |
| ASAL | Arid and Semi-Arid Lands |
| ASARECA | Association for Strengthening Agricultural Research in Eastern and Central Kenya |
| ASCU | Agricultural Sector Coordination Unit |
| AU | African Union |
| CAGR | Compounded Annual Growth Rate |
| CH | Central Highlands |
| CIF | Cost Insurance and Freight |
| CL | Coastal Lowlands |
| COMESA | Common Market for Eastern and Southern Africa |
| DAP | Diammonium Phosphate |
| DSL | Dryland Seed Company Limited |
| EAC | East African Community |
| EAGA | East African Growers Agriculture |
| EASEED | East African Seed Company Limited |
| EL | Eastern Lowlands |
| FAK | Fertiliser Association of Kenya |
| FAO | Food and Agriculture Organization |
| FAQ | Fair Average Quality |
| FCI | Farm Concern International |
| FEWSNET | Famine Early Warning Systems Network |
| FPEAK | Fresh Produce Exporters Association of Kenya |
| FTF | Feed the Future |
| GCI | Global Competitiveness Index |
| ha | Hectare |
| HCDA | Horticultural Crops Development Authority |
| HP | High Potential |
| HRI | High Rainfall I |
| ICBT | Informal Cross-Border Trade |
| IFPRI | International Food Policy Research Institute |
| IPM | Integrated Pest Management |
| IPDM | Integrated Pest and Disease Management |
| JKUAT | Jomo Kenyatta University of Agriculture and Technology |
| KAINet | Kenya Agricultural Information Network |

| | |
|---|---|
| KARI | Kenya Agricultural Research Institute |
| KEBS | Kenya Bureau of Standards |
| KEPHIS | Kenya Plant Health Inspectorate Services |
| kg | Kilogram |
| KHE | Kenya Horticultural Exporters |
| KPLC | Kenya Power and Lighting Company |
| KSC | Kenya Seed Company |
| KSh | Kenyan Shilling |
| KVC | KAVES Value Chain |
| LPI | Logistics Performance Index |
| MOA | Ministry of Agriculture |
| MRS | Marginal Rain Shadow |
| MT | Metric Ton |
| NAAIAP | National Accelerated Agriculture Input Access Programme |
| NGO | Non-governmental organizations |
| PCPB | Pest Control Products Board |
| PHL | Post Harvest Losses |
| PMG | Producer Marketing Group |
| ppb | Parts Per Billion |
| PSDA | Promotion of Private Sector Development in Agriculture |
| RRA | Rapid Rural Appraisal |
| SA2 | Semi-Arid 2 |
| SACCO | Savings and Credit Cooperative Society |
| SSA | Sub-Saharan Africa |
| STAK | Seed Trade Association of Kenya |
| TMT | Thousand Metric Tons |
| t/ha | Tons per hectare |
| USAID | United States Agency for International Development |
| USAID-KAVES | Kenya Agricultural Value Chain Enterprises |
| USAID-KHCP | Kenya Horticulture Competitiveness Project |
| VAT | Value Added Tax |
| WH | Western Highlands |
| WHSL | Wholesale |
| WL | Western Lowlands |
| WSC | Western Seed Company Ltd. |
| WT | Western Transitional |