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Analysis of potato production in Kenya.

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Abstract

Potato production plays a significant role in Kenya's agricultural economy, providing food security, employment, and income for approximately 2.5 million farmers and actors across its value chain. The sector is marked by persistent challenges that constrain productivity, competitiveness, and profitability. This paper examines the outlook, value chain dynamics, and constraints affecting potato production in Kenya. Using data from government reports, the National Potato Council of Kenya (NPCK), and international comparisons, the analysis reveals that Kenya's average yield of 8.4 tons per hectare lags far behind regional and global averages. The primary barriers include limited access to certified seed, weak extension services, overreliance on rainfed agriculture, and inadequate farmer knowledge of Good Agricultural Practices. Post-harvest losses, estimated at 9 percent, further erode farmer incomes and market inefficiencies leave producers with low incomes. The study underscores that without targeted interventions, the sector will continue to underperform relative to its potential to drive rural livelihoods, women livelihoods and national food security. The paper recommends strengthening extension services, promoting climate-smart agriculture, enhancing farmer organization through cooperatives, and seeds subsidies. Investment in seed systems, contract farming arrangements, and digital information platforms could significantly improve productivity and bargaining power for smallholder farmers. The findings highlight the need for coordinated action by government, private sector, and farmer organizations to close the yield gap, reduce losses, and unlock the full potential of potato farming in Kenya.

Key Words: Agriculture, Productivity, Seeds, Potatoes, Women Labour

1.0: Introduction

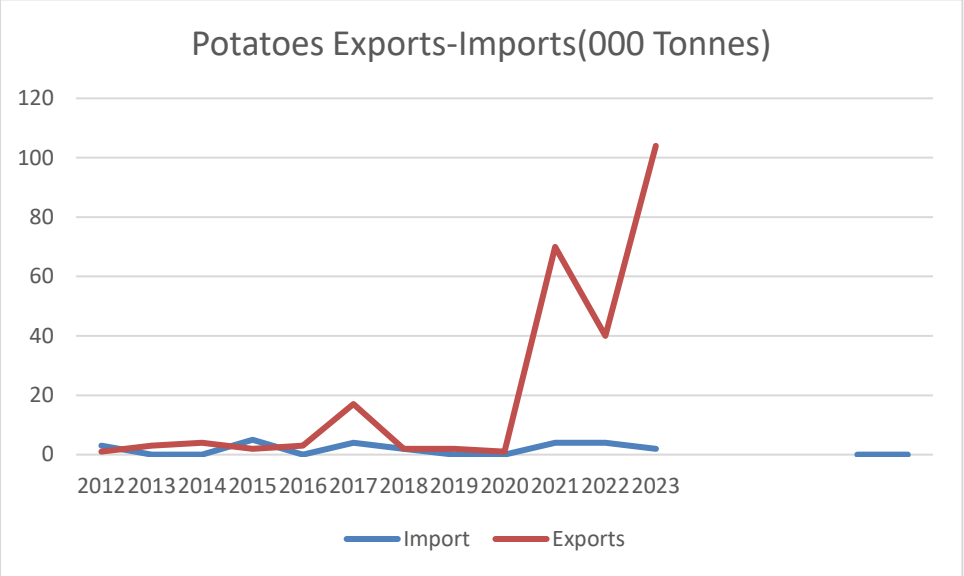
1.0.1 Arising Issues in the Potato Industry.

Irish potato, Solanum tuberosum L., are among the leading food crops in Kenya. Nevertheless, farmers have raised concerns on farmgate market dynamics, in essence, produce prices, and production cost as well as resources available at their disposal. The potato supply side has been faced by different questions surrounding its production, distribution and storage.

Continuously, claims and counterclaims are exchanged in the public domain on the returns per unit at the producer market compared to the returns per unit at the retail and wholesale market. The difference in price between a producer market item in comparison to the consumption item at the retail and wholesale market has seen the suppliers, political class, and community raise concerns. Can farmers earn better? What is the role of government in this chain?

The potato sector can be divided into the demand and supply side. The potato sector supply side entails potato production for the market while the demand side is characterised by consumption and processing of potatoes. The supply side faces land preparation, seeds, diseases and pest management, and the production phase from extension services, planting, weeding and harvesting. Potatoes and their products consumers and processors are more interested in fulfilling their preference such as variety, size and taste of the tubers. Kenya's potatoes take about 4 months from planting into maturity before harvest giving farmers an average of three crop season in a year, the distribution chain from brokers and transporters, and direct interactions to consumers such as retailers and wholesalers. Irish potato in the country is dominated by local produce with low imports and exports (Wakaba et al., 2022) as illustrated in fig. 1 below.

Figure 1: Potatoes Exports-Imports (000 Tonnes)



Source: Kenya Economic Surveys, 2012 - 2024

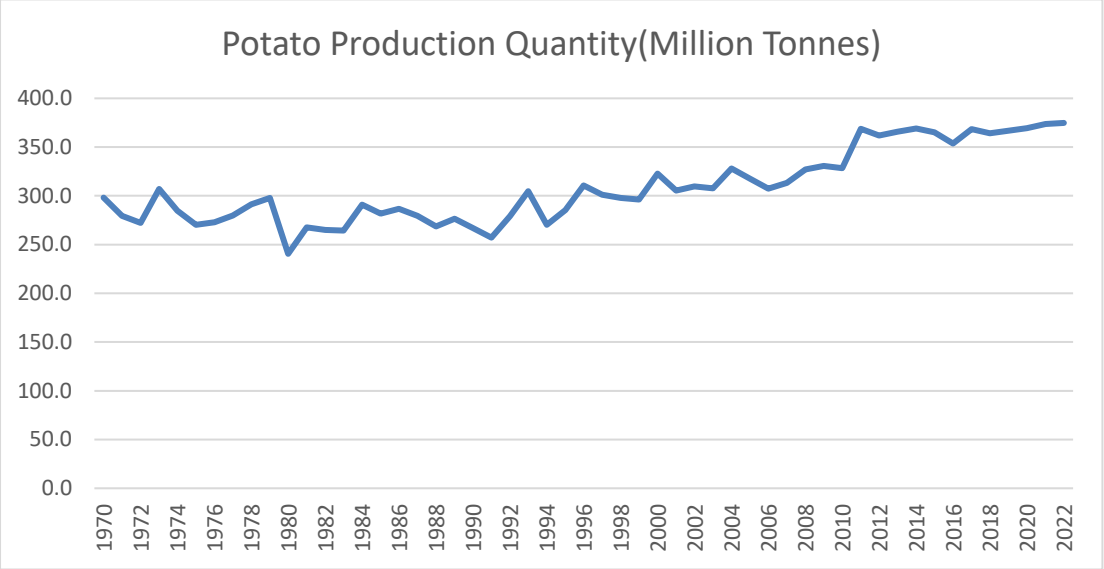
The sector suffers from various hurdles that have a slowing effect on the potato sector growth spanning from pre-planting to post harvest issues.

Agricultural food products: maize, tea, coffee, sugarcane, and potato farming amongst others, faces price fluctuations often due to seasonality, weather influenced, of production in the sector. Various government interventions and regulations have been adopted over time to answer these cries including packaging thresholds, and price caps setting. The paper aims to answer the question: Why farmers are seen to earn less, amounting to claims of exploitation by middlemen, market forces, and government agencies.

1.0.2 Potato Sector Outlook

Potato is among the leading root vegetables in the world. In production volumes, they are the third most important food crop after rice and wheat worldwide (CIP, 2024). Potato can be processed into different products by roasting, mashing, baking, or boiling them. China is the highest producer of potatoes, contributing about 95 million metric tonnes of the 375 million metric tonnes produced in 2022 (FAO, 2024) illustrated in Figure. 2.

Figure 2: Global Potato Production



Source: FAOSTATS Potato Dataset, 1970-2022**.**

The international potato market exchange involves fresh and chilled potatoes as the leading international product. Potato production has increased since potatoes were rehabilitated in the Andes, South America as illustrated in fig. 2. According to the Observatory of Economic Complexities (OEC), potato trade globally in 2022 was worth $5.31 billion. The Netherlands, France, Germany, Canada and Egypt were the leading exporters of potatoes in 2022 and Belgium, Netherlands, USA and Germany as the leading importers.

Increased adoption of technology in the potato processing market continues to aid in the growth of returns with reduced wastage, high-quality potato production cum efficient operations proving crucial to production and consumption levels of the sector. Irish potato has the potential to aid in the stabilisation of the world's food security (Menza et al., 2014). Food and Agriculture Organization (FAO) statistics in 2022 show the world produced 374.8 million tonnes, with Africa producing 27.1 million tonnes while Kenya's output stood at 1.8 million tonnes as show in fig. 5. With the looming climate change impact across the globe, potato production in Africa is likely to shrink, a 22% shrinkage is projected against Sub Saharan Africa (SSA) (Ogola & Ouko, 2021).

2.0 Potato Value Chain: Kenya.

2.0.1 Background

Irish potato is the second most important food crop in terms of production volumes after maize in Kenya (Gikundi et al., 2023) whose importance is corroborated by (Europatat, 2024) highlighting the rich nutrient component it holds which includes starch, Vitamin B and C amongst others which are critical to the human body.

Irish potatoes do well in high areas with Nyandarua, Nakuru, Kiambu, and Uasin Gishu among the leading producers due to their rainfall level. Compared to other crops, Irish potatoes have a lower maturity span of between 70 and 120 days, making them viable for high-yielding. Potato farming in Kenya is mainly done at a small-scale level at the household level.

Agriculture contributes directly about 20% and 27% indirectly to the Gross Domestic Product (GDP) in Kenya employing 70% of rural employees aggregating to 40% nationally(CBK, 2023), agriculture is a critical sector in the country, where potato farming provides a significant contribution. Potato sales in Kenya amount to about $500 Million, creating over 2.5 million jobs annually (Kuhlmann et al., 2022). Potato production is also critical in the food security basket providing for starch in the developing world. Climate change poses a danger in the sector. Despite the emergency of climate Smart Agriculture(CSA), CSA penetration in the agriculture sector in Kenya is inhibited by inadequate know-how by a majority of farmers (Ogola & Ouko, 2021).

According to a survey carried out by NPCK on behalf of German Federal Ministry for Economic Cooperation and Development (BMZ) in different villages in 4 counties in Kenya, potato farmers through multiple choice raised concerns on the prices, diseases, demand, inputs, seeds, and storage as the major challenges they face in their daily production of potatoes as shown in Table 1.

Table 1:Main Challenges Farmers Face in Potato Production as a % (multiple choices)

Challenges	All	Bomet	Meru	Nakuru	Nyandarua
Prices	98.4	98.1	96.2	100.0	98.6
Disease	97.2	96.2	98.1	95.7	98.6
Market Demand	91.5	88.5	81.1	94.2	98.6
Inputs	89.5	82.7	83.0	88.4	100.0
Seeds	87.4	84.6	77.4	87.0	97.3
Storage	79.4	67.3	67.9	78.3	97.3
Mechanisation	70.9	82.7	20.8	88.4	82.2
Irrigation	60.7	50.0	56.6	58.0	74.0
Losses	59.9	53.8	30.2	68.1	78.1
Others	27.5	36.5	0.0	31.9	37.0

Source: USAID_KAVES, 2015 Survey Reports

2.0.2 Pre-Production Level

2.0.2a) Pre-production

Substantial increases in production and distribution costs in the potato sector necessitate the adoption of information exchange, cultural, and pest control management integration, technological application, and artificial intelligence application in the production of potatoes, (Stark et al., 2020) this should be done with a localisation approach tailoring each tool to the relevant setting to avoid a copy-paste approach.

Pre-production of potatoes includes vast activities that are highly neglected due to inadequate information flow amongst farmers and understaffed extension system. Land identification, preparation, seed production, seed variety selection, pest management, and planting are key pre-production activities that form the basis of potato farming.

Potato farming is faced with limited adoption of new knowledge in farming. (Godtland et al., 2003) emphasise the importance of knowledge in production and pest control to increase production. Additionally, extension officers provide necessary information tools to guide farmers to optimise their production through maximizing resources utilisation and production cost minimization.

Kenya yields 8.4 tonnes per hectare of potatoes, 2.5 times short of the global yield and about half of the African aggregated yield level. The low yield is explained through various factors in the sector such as the

key pressing issues in the field such as seeds quality, weather, soil quality, land size, and the reducing production per capita index which has slowed by about 7.5% compared to 2014-16 base year (FAO, 2024).

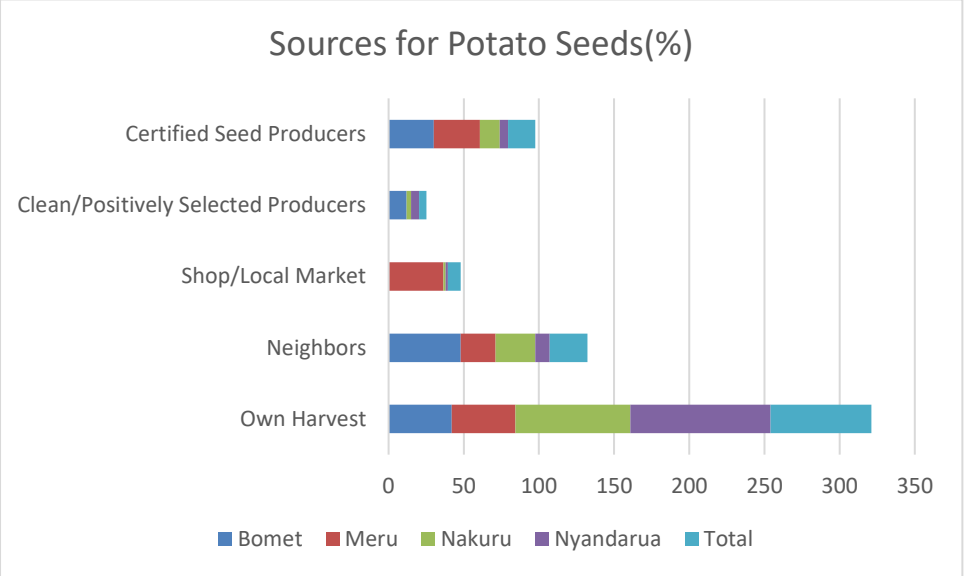
2.0.2a: Extension Services

Kenya's extension program has a shortage of officers from the public sector and an inadequate incentive to the private sector to provide the services to the farmers. The majority of farmers in the potato production chain are small-scale farmers with low income levels hence the private sector lacks incentives to provide extension services. Extension services agents ratio is recommended at 1:400 (Government of Kenya, 2012) by FAO for effective operation, contrary, Kenya's extension services ratio is at 1:800 (Fiona Mwaniki, 2019). Global dynamics shows small-scale holders contribute about 60 percent of global agriculture (Fiona Mwaniki, 2019) explaining the consequential potential of optimising small-scale production in the potato sector.

2.0.2b: Seeds

Clean and certified seeds are a vital component of efficient production in the potato industry. Majorly, seeds availability, costs, and availability of knowledge of their application remain key issues potato farmers faces and in extension the agriculture landscape in the country (Karanja et al., 2014). Typically, small-scale farmers depend on the market rejects and small-size outputs from their farms or their neighbours as shown in fig.3 as seeds for the next planting season, the rationale in this is to ensure what can't be sold should be replanted for possible production of a market-size output. Agriculture is prone to diseases that are easily transferred across different seasons when farmers utilise uncertified seeds which in response reduces production efficiencies. Certified and clean seeds are tailor made to match the weather and soil quality of a particular area. Kenya's potato productivity of about 8 tonnes/ha is far behind Africa's major producers South Africa and Nigeria whose productivity is at 35 tonnes, and 25 tonnes respectively (Judy Kaaria & Dan Basil, 2022). Empirical evidence points to seed-driven potato diseases and pest infestation in Kenyan potato production amplifying the cost incurred on farmers and stakeholders for usage of uncertified and non-clean seeds in the sector. NCPK shows Kenya has about 30 potato seed merchants. Farmers continue to use unclean and uncertified seeds despite knowing the high returns that can be yielded as a result of using the right seeds as corroborated by (Aheisibwe et al., 2015) and (Atieno et al., 2023) in their research in Uganda and Kenya respectively.

Figure 3: Main Sources of Seeds

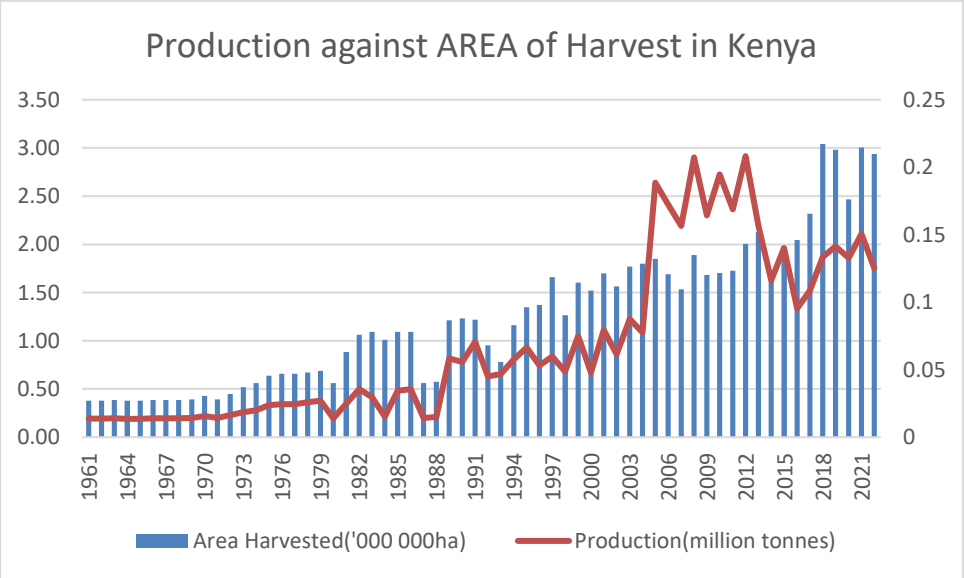


Source: USAID_KAVES, 2015 Survey Reports

2.0.3 Production Level

2.0.3 a) Production

Figure 4: Land Productivity

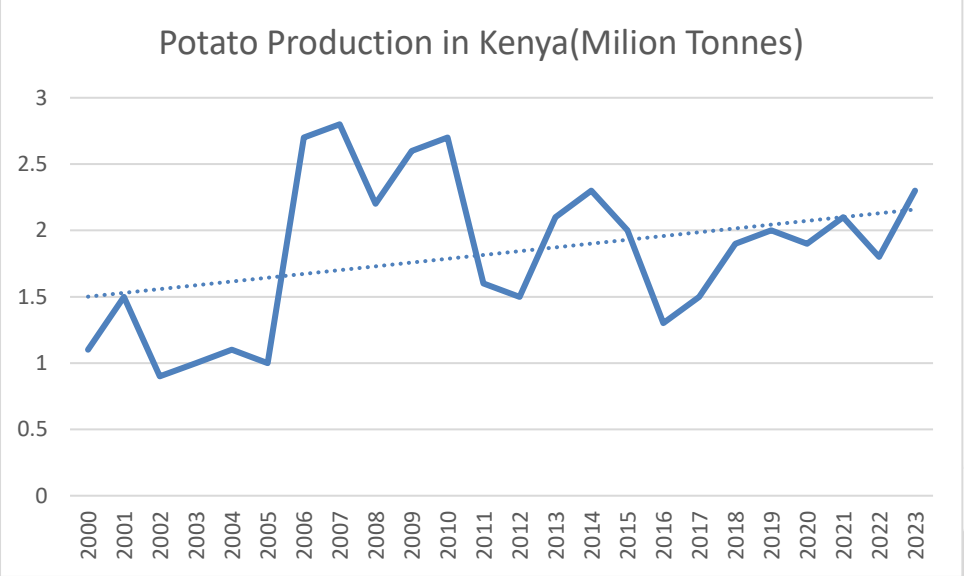


Source: FAOSTAT, 1961-2024.

Kenya's potato farms' productivity is about 18% of global productivity leaving a vast income gap to farmers (MoALF&C, 2021). The potato production sector in the country is far behind in reaching its

potential. Challenges emerging from pre- and during potato production including knowledge gap, pests and diseases, farming techniques, and rain dependency farming contribute to this shortfall. Despite the incremental trend of the harvest area the volume of outputs has not been increasing at a similar percentage as illustrated in fig. 4.

Figure 5: Potato Production in Kenya.



Source: Economic Survey, Kenya, 2003-2024.

Potato farming is rain-dependent especially small-scale farming. Hence, it is done in high altitude areas, 1500-2800 Metres above sea level, with an average rainfall of 850mm to 1200mm per annum, and cool temperatures(CKL Africa Ltd, 2020). Despite the inclusion of large-scale farmers, the sector remains small scale across the country. The significant potato-producing counties in Kenya include Meru, Nyeri, Nyandarua, Kiambu, Taita-Taveta, Nakuru, Narok, Bomet, Elgeyo Marakwet, Trans-Nzoia, Bungoma, Uasin-Gishu and West Pokot as well as counties such as Kisii, Nyamira, Kirinyaga, Muranga, Baringo, Nandi, Laikipia and Kericho who produce at a lower capacity (MoALF&C, 2021).

Potato farming has been experiencing an increment in the harvest area as shown in Fig. 4, new entries have entered sectors such as Tana River, Kirinyaga, and Naivasha (Mbugua et al., 2017), and a shift from other sectors to potatoes has been experienced in counties such as Nakuru shift from pyrethrum. These changes in land mass, areas and labour utilisation in part explains the increase in potato production over the years as shown in fig. 5.

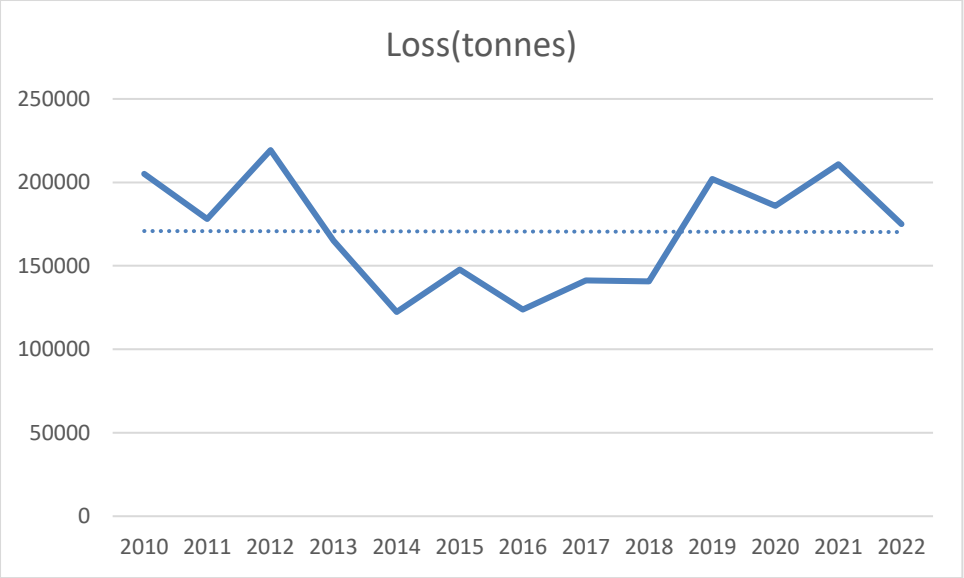
According to the Meteorological Department reports Kenya has two major rainy seasons: long rains in May and short rains around October. Given these two seasons, farmers have about three growing seasons within the main frame although due to wait time and preparation gaps most farmers have two harvest seasons. Potatoes are highly affected by water stress, affecting

their quality and quantity. Irrigation offers an alternative to ensure that potato farming can be done throughout the year and that the quantity and quality are preserved, hence ensuring a higher yield (Abubaker et al., 2014).

2.0.3 b) Harvesting

Potato maturity depends on its variety which averages at about 70-120 days. Potato harvesting in Kenya is done manually or using machines. Different tools can be used to harvest potatoes: fork, plow, and potato harvesters. Small-scale potato farmers depend on casual laborers to help in the preparation, weeding, and harvesting of potatoes to save on the cost of production. Potato production experiences very high losses, averaging at 9% over the last 11 years as per the FAO data for Kenya of produce being lost annually, these losses aggregate to about Ksh. 12 billion losses annually (Wachira Kaguongo et al., 2014). A high percentage of the wastages and losses are accounted for at the production level and market storage due to the utilisation of inefficient harvesting tools, traditional storage and the knowledge gap in the sector. Forks or hand hoes as well as ox drawn ploughs have high losses in terms of potatoes left on the ground and those damaged in the process. The wastages and losses are escalated further when selecting potatoes for the market as only the medium and large size potatoes are qualified for the market. The small size is consumed at the subsistence level or used as seeds further affecting the upcoming season as small size is an indicator of the potato's health.

Figure 6: Potato Losses in Kenya



Source: FAOSTATS 2010-2022

Harvesting techniques also impact the duration between harvesting and the next planting, with potato harvesters leaving the land much better making it easier to prepare it for the next season in a shorter span

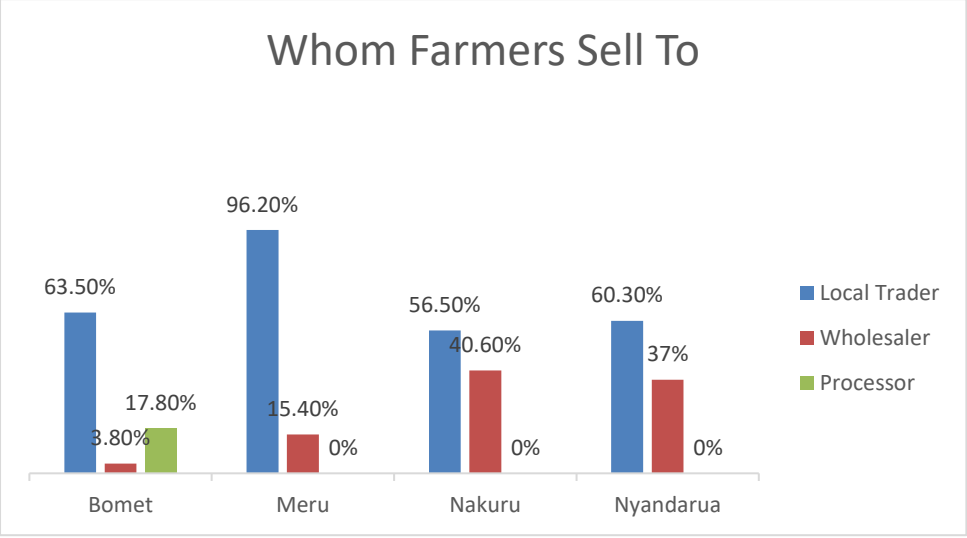
(Wasukira et al., 2017). Despite the losses shown in fig. 6 and time inefficiency, small-scale farmers are still reliant on manual potato harvesting mechanisms.

2.0.4: Post Production.

Potato distribution is done by various players: farmers, brokers, local traders, brokers, or wholesalers. The Crop Act 2019 regulates potato and other tubers packaging: natural and synthetic fiber sacks, moulded plastic boxes, sawn wooden boxes, and plastic film sacks (ALFI, 2019). Nairobi, Nakuru, Meru, Nyandarua, and Mombasa form the biggest market for retailing and wholesaling of potatoes with Gikomba, Githurai, Wakulima Nairobi, Kangemi, Kongowea Mombasa and Wakulima Nakuru being the leading markets(Wachira Kaguongo et al., 2014).

Potato distribution is mainly is done by local traders and brokers, the biggest producer market buyers. The producer market metric of measurement is sack sizes. Brokers and traders dictate potato packaging, fig.8, they form the main players in potato trade. Potatoes are sold at an average weight per package of 173.5 kg at the producer market contrary to the recommended 50kg per package by the Crop Act. Sacks, containers, kgs are some of the measurement mechanisms adopted in the potato sector. Market metric disparities are a source of price instability and reliability calling for harmonisation of the markets price determination mechanisms.

Figure 7: Who the Farmers Sell To.



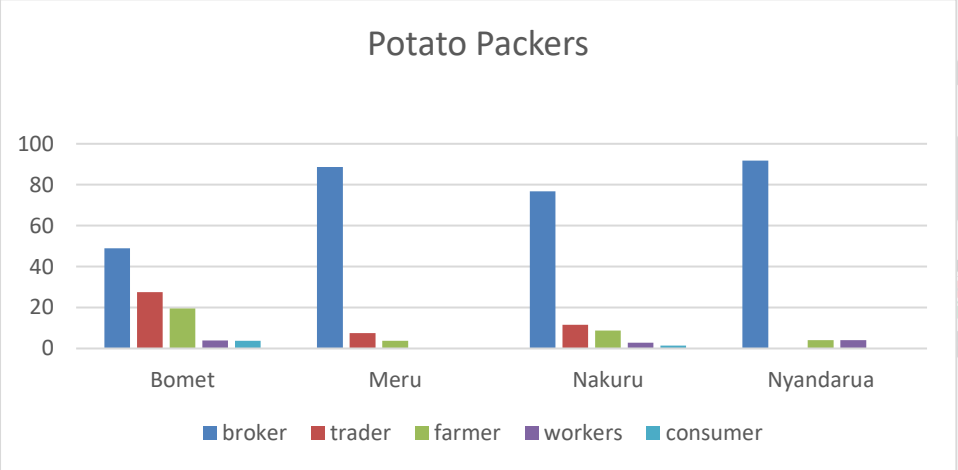
Source: USAID_KAVES, 2015 Survey Report

2.0.4a) Storage

Potato storage technology is built around the requirement of cool temperatures to store potatoes. Potatoes have diverse utilisation hence, dictates different conditions for their storage including temperature degrees: 3-5 for seed and table potatoes, 5-8 for fries, and 7-11 for chips, a mechanism to reduce water loss from

the tubers, maintaining humidity and Carbon (iv) Oxide level (Sergey Matskevich, 2020). Farmers in Kenya are lagging behind in creating microclimate storage units due to knowledge gaps and cost implications. Farmers temporarily store the tubers by covering them on the ground, bagging them, or moving them to stores(Wachira Kaguongo et al., 2014). The applied storage mechanisms are ineffective increasing potatoes shelf life by a few days. The inadequacy of the potato storage mechanism sees an almost doubling of prices during a production trough compared to peak production. Rain-fed potato production sees that most small-scale farmers sell during the peak and are without produce during the troughs hence they miss the market price gains. The most utilised potato storage is sacks which are temporarily used to measure the quantity, pack for distribution and also to act as storage kits. Potato packaging is domineered by the brokers and traders, Fig. 8, shifting the costs from the farmers although a part of it is reflected in the buying price which is mostly set by the brokers and traders citing their market knowledge.

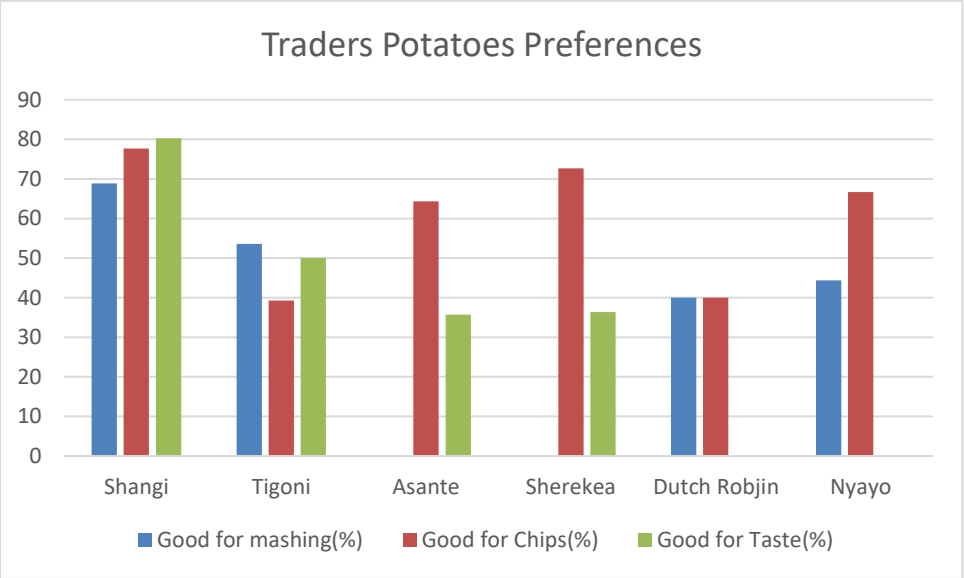
Figure 8: Potato Packers (Select Counties, Kenya)



Source: USAID_KAVES, 2015 Survey Report

The potato value chain is pegged on selling of raw potatoes with the local market taking 80% of the market share with restaurants and processing being the other significant market sharers as in Fig. 7. Different aspects of potatoes determine their market share based on traders' preferences advised by consumers' tastes. Shangi variety commands a huge preference with its taste, size, and ability to be mashed being among the key contributors in the market as shown in Fig. 9.

Figure 9: Traders Preferences (%)



Source: USAID_KAVES, 2015 Report

3.0 Conclusion

Farmers greatest hurdle to better income levels is low productivity against a high productivity potential due to tools used, knowledge available and different climatic conditions in a particular area and time. Potato value chain potential is highly inhibited. Farmers produce at only 18% of global level productivity of farms with an additional 9% loss of the harvest due to knowledge gaps, pests and diseases, use of traditional means, and cost implication of clean and certified seeds. Farmers income levels have a huge incremental space and thus their income can change if new approaches are localised to allow all farmers to optimise their productivity. Farmers income level can rise beyond its current level considering the significant difference among farmers along quantity and quality lines of their produce. The producer market cost as reported by FAO, 2024 in Kenya was $186,500/Tonne in 2022 which is higher than the one of the leading Exporter and importer of potatoes, Netherlands, which was at $ 159,100/Tonne in 2022. The high prices challenge the argument of low return to farmers due to farmgate prices in Kenya.

Information asymmetry is a huge disadvantage against farmers. Flooding the market with information will allow better bargaining power for farmgate prices or organize to reach the retail market at leading markets. Knowledge gap thinning would revamp the sector to a greater height consequently improving the livelihood of the about 2.5 Million workers in the sector and contributing indirectly to anyone involved in the chain.

Better quality, preferred taste, suitability to processing remain considerations that should advice farmers

in their production journey. The Aga Khan Women Buyers are an example of higher quality potatoes attract better income. The Aga Khan Women buyers buy high quality potatoes from the farmers through visiting farms, sorting the desired sizes and then pay higher than the local market. The buyers also make promises to buy from farmers during their planting season with the caveat of they will only pay for what meets their standards.

4.0 Policy Recommendation

Information Asymmetry

Government should flood the market with potato production information given information is a public good. Farming in the country has remained regional and inheritance passed in the country(Żmija et al., 2020). The generational passing of farming sees the continuity of production of farms, nevertheless, region and family production sometimes falls short due to stickness to what is produced and how it is produced. Despite the young people's willingness to embrace change in the agriculture sector, it is slow and faces a challenge due to community land ownership structure. Free and cheap market analysis provisions are key if farmers are to be incentivised to produce using modern tools and also accept product shifts if the markets shift. Market knowledge for example would advise farmers producing potatoes with the preferred taste for French fries which accounts for the highest potato processing percentage. Market knowledge is expensive and the flow is inhibited but advances in technology offer a reprieve on that if utilised.

About 5% of potato farmers inferred from a survey by NPCK are illiterate, 38% have primary education, 44% have secondary level education with only 13% enjoying post-secondary education. With a need to adapt to clean and certified seeds, mechanisation of potato farming, and pest and disease control technologies the limited education capacity is a huge stumbling block. Additionally, the knowledge gap occasioned by the limited access and strained extension services limits efficiencies in the potato value chain. The average age of potato farmers and traders is about 40 years as shown in Table 2.

Table 2: Characteristics of potato farmers and traders

Farmers

	Male	Female	All
Illiterate	2.4	10.3	4.9
Primary	34.3	46.2	38.1
Secondary	47.9	34.6	43.7
Post-secondary	15.4	9	13.4

Traders	Retailer	Wholesaler	Both Roles	All
Age of respondent	40	38	35	38
Number of years in potato business	8	10	6	9
Level of education (%)				
Primary and below	33.3	33.3	33.3	33.3
Secondary	40.7	37	33.3	38.1
College and A-level	22.2	39.6	22.2	25.4
No education	3.7	0	11.1	3.2
	n=247			

Source: USAID_KAVES, 2015 Report

In consideration of the above realisations, knowledge acquisition must be incentivised with an age consideration. The farmers should be incentivised through paid training on the losses incurred, the causes, and how to handle them. This should be matched with improved extension services to ensure any new knowledge and/or any inquiries pertaining potato farming and its value chain are handled timely and within the required parameters.

Extension Services

Given the public constraint on extension services, the government should consider incentivising private extension services by pushing demand through open vouchers to encourage different farmers to seek these services and create supply by ensuring the farmers can meet the market price of the services.

Open vouchers are advantageous as they will allow farmers to: seek services on a need basis, seek only the relevant services, and encourage private provision for the extension services resulting in improved competition in the field which consequently improves the technology adoption and resilience with time.

In the wake of the digital landscape, a combination of tradition and digital extension services will be critical in challenging the huge knowledge gap. With increased electricity and phone penetration, it offers a chance to increase targeted digital agricultural extension services.

Potato Cooperatives

Adoption of new technology required to ease access to information, process potatoes, and allow potato storage is capital intensive. Small-scale farmers lack the income bandwidth to adopt clean and certified seeds, buy cold storage, do consistent soil checks, and pay for extension services and training. A joint effort amongst farmers through a pooling of resources (EOS, 2024), and the organisation of potato farmers and traders into a cooperative would help to actualise this. A cooperative will encourage a joint investment into the necessary services and capital requirements to make farming more efficient and thus improve the output and productivity of farmers (CHIYOGE B SIFA, PhD, 2014). Cooperatives in addition will help build trust amongst farmers a key factor deficient in the field. Trust reduces the transaction costs and will result in a friendlier approach to trade, and exchange of information and act as a motivation for new entry into the field due to cooperatives act as an open avenue to interact with the sector.

Cooperatives are avenues of optimisation of economies of scale in fertiliser, seeds, and extension services acquisition amongst the farmers and traders. Additionally, the cooperatives can enter into partnerships and lobby for establishment of potato weighting mechanisms, lobby for development of cold chains and finance its members to allow for growth in the sector.

Packaging

There is need to adapt a harmonized market measurement mechanism for potatoes. The producer market is dominated by sacks size as the measurement metric. The retail market utilisation of weight and/or sacks as the measurement market diverges from the producer market. The government push to have potato packaged in 50kg bags disadvantages the transportation sector since potatoes are bulky and higher kgs packaging allowing the transportation easing. Adoption of a unified measurement mechanism will reduce the exploitative nature of bags as unit of measure dictated by the packers and brokers at the producer market.

Contract Farming

Contract farming ensures collaboration between farmers and traders or processors(khetiBuddy_admin, 2024). The collaboration between production and secondary consumption is key to ensuring there is quality production. Contract farming incentivises the adoption of new technologies, clean seeds, and usage of best practices to ensure efficient production to avoid loss on the farmer's part and also to ensure the traders and/or processors are assured of a constant flow of products to secure their market share. Contract farming is a key precursor to see the farmers have a mindset shift from traditional production which has proven to be ineffective.

Seed Subsidies

Seeds are amongst the most important inputs in potato production. The limited supply and production of potato seeds as well as the cost of both the seeds and their utilisation requires a government intervention at least in the short run to boost productivity in the sector. Government should consider subsidizing the potato seeds for farmers. The subsidy level could be substituted against the fertiliser subsidy or done in tadem.

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