

A policymakers' guide to crop diversification:

The case of the potato in Kenya



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Acronyms and abbreviations

ADC	Agricultural Development Corporation (Kenya)
AFSTA	African Seed Trade Association
AGM	Annual general meeting
AGP	Plant Production and Protection Division (FAO)
AGRA	Alliance for a Green Revolution in Africa
APVC	Agricultural Product Value Chain
ASAL	Arid and semi-arid land
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASDS	Agricultural Sector Development Strategy (Kenya)
ATC	Agricultural Training Centre
BAF	Business Advocacy Fund
BMZ	Federal Ministry for Economic Cooperation and Development (Germany)
BW	Bacterial wilt
CAADP	Comprehensive Africa Agriculture Development Programme
CFC	Common Fund for Commodities
CIP	International Potato Center
DAO	District Agricultural Office
DLS	Diffused Light Storage
DNA	Designated national authority
DUS test	Distinctness, Uniformity and Stability test
EAAPP	Eastern Africa Agricultural Productivity Project
EAC	East African Community
EAS	East African Community Standard
ESS	Statistics Division (FAO)
EST	Trade and Markets Division (FAO)
FG	Farmer group
FIPS	Farm Input Promotions
FPEAK	Fresh Produce Exporters Association of Kenya
GAP	Good agricultural practices
GDP	Gross domestic product
GIZ	German Agency for International Cooperation
GMP	Good manufacturing practices
GTIL	Genetic Technologies International Limited
GTZ	German Agency for Technical Cooperation

ICT	Information and communications technology
ID/OS	Institutional development and organizational strengthening
ILO	International Labour Organization
ISTA	International Seed Testing Association
KAPAP	Kenya Agricultural Productivity and Agribusiness Project
KAPP	Kenya Agricultural Productivity Project
KARI	Kenya Agricultural Research Institute
KCB	Kenya Commercial Bank
KEBS	Kenya Bureau of Standards
KENAPOFA	Kenya National Potato Farmers Association
KENFAP	Kenya National Federation of Agricultural Producers
KEPHIS	Kenya Plant Health Inspectorate Services
MDF	Multidisciplinary Fund (FAO)
MDG	Millennium Development Goals
MoA	Ministry of Agriculture (Kenya)
NAAIAP	National Accelerated Agricultural Inputs Access Programme
NARL	National Agricultural Research Laboratories (Kenya)
NCST	National Council for Science and Technology
NMK	Njaa Marufuku Kenya
NPCK	National Potato Council of Kenya
OECD	Organisation for Economic Co-operation and Development
PLRV	Potato leaf roll virus
PPP	Public-private partnership
PS	Positive selection
PSDA	Promotion of Private Sector Development in Agriculture
PSS	Positively selected seed
PVY	Potato virus Y
QDS	Quality declared seed
RTA	Round Table Africa
SANAS	South African National Accreditation System
SHOMaP	Smallholder Horticulture Marketing Programme
SSA	Sub-Saharan Africa
SWOT	Strengths, weaknesses, opportunities and threats
TC	Tissue culture
TOT	Training of Trainers
UPOV	International Union for the Protection of New Varieties of Plants
USAID	United States Agency for International Development
WB	World Bank
WTO	World Trade Organization

Foreword

The potato is an important crop in Kenya, with a production in 2010 of around 1 million tonnes. The tuber is attracting great interest as one possible answer to the multiple challenges the country faces, including hunger, poverty and climate change. With some 800 000 potato growers, millions of rural and urban consumers and an estimated production value (at farmgate prices) of KES 13 billion (USD 150 million) a year, the potato has become one of Kenya's strategic food commodities. A growing consensus in Kenya considers that by boosting food security, raising incomes, generating employment and improving nutrition, potato production could make an even greater contribution to achieving the objectives of Vision 2030, the national long-term development blueprint that aims at transforming Kenya into an industrializing, middle-income country.

The potato is an ideal candidate for crop diversification programmes in Kenya. Many rural households already depend on the tuber as a primary or secondary source of food. Potatoes are rich in protein, calcium, potassium and vitamin C and have a good amino acid balance. Moreover, the potato is a highly productive crop. Compared with wheat, rice and maize, it produces more food per unit of area and time. It has a short and highly flexible vegetative cycle and can be harvested within 100 days of planting. Another of the crop's attributes is its great adaptability to almost any altitude and to a wide variety of climates, including arid and semi-arid lands. It is already cultivated as both a primary and off-season crop in different parts of Kenya.

The potato can be intercropped with many cash and food crops, and rotated with crops such as barley, maize and wheat. The tuber's low fuel requirements and short cooking time, and its potential for value addition – e.g. chips and crisps – make the potato popular with both rural and urban consumers. Furthermore, the crop generates considerable employment in production, marketing and processing.

The potato is also insulated from international price shocks as, unlike major cereal commodities, it is traded sparingly in global markets. Only a fraction of its total production enters foreign trade – and then mainly as processed products. Thus, potato prices in Kenya are determined by local demand and supply conditions, not by the vagaries of international market speculation. In addition, since potatoes are not massively traded in major international commodity exchanges, the crop is not at risk from the ill-effects of speculative activity. The potato is a highly dependable food security crop and can help reduce imbalances in Kenya's food supply and demand.

Despite its excellent potential for contributing to the growth of Kenya's economy and improving the welfare of poor households, the potato subsector has been hampered by many complex constraints. They include:

low yields; high disease incidence; shortage of suitable varieties; limited production, distribution and use of quality planting material; fragmentation of actors in the value chain linking producers and consumers; and the lack of value-added and new product development.

A concerted effort is needed to fully realize the potato's potential to help improve livelihoods, reduce poverty and enhance food security in Kenya. Full implementation of the policy guidelines presented in this document can stimulate accelerated growth in potato production and use, and make an important contribution to helping producers and consumers reap the benefits of doing so.

While aimed primarily at policymakers in Kenya, the guide is also of use to decision-makers at institutional and policy levels in other countries of Eastern and Central Africa. It will help further the realization of the potato's full potential as a high-value crop in response to emerging opportunities, such as changes in consumption pattern and the resulting need for value addition due to rapid urbanization, and to potential threats, including climate change and food price surges causing upheaval in international food markets.

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Executive summary

A key challenge facing Kenya is to ensure the food and nutrition security of present and future generations while protecting the country's natural resource base. Kenya's population currently stands at about 40 million and is projected to reach 60 million by the year 2030. Kenya remains a food-deficit country even in bumper harvest years. Discussions of food security in Kenya usually revolve around maize, since the country's food security is overwhelmingly dependent on it, despite a continued structural deficit in maize production. Overall, vulnerability to food insecurity in the country is exacerbated by the absence of substantive diversification in food production and consumption.

Annual per capita consumption of maize in Kenya is estimated at 98 kg. That translates into an equivalent overall demand of about 40 million bags every year. Domestic maize production is around 25 million bags, reaching 40 million in a good year. Food prices have generally been on the increase in Kenya in the recent past, owing to a combination of factors, including droughts, global price trends and government policy. The recent high prices of food and fuel are also challenging some of Kenya's macroeconomic fundamentals because they have resulted in higher inflation (estimated at more than 10 percent over the last few years) and contributed to a sharp decline in the foreign exchange rate. Diversifying the country's food base is therefore an important strategy for reducing Kenya's vulnerability to international food price shocks. Additionally, since average arable land per household is shrinking rapidly owing to a combination of rapid population growth and continued urban sprawl, crops that can produce more food, more nutrients and more cash per unit area and time are gaining increasing importance in the quest for solutions to Kenya's perennial food security problems.

One of the long-term strategies to ease the strain of food price inflation is diversification of the crop

base with a focus on nutritious and versatile staple foods which are not susceptible to the vagaries of international commodity markets. Given its numerous favourable attributes, the potato is a suitable candidate for crop diversification in Kenya. The crop has wide acceptance, and many households already depend on the potato as a primary or secondary source of food and nutrition. The potato is highly nutritious: it is rich in protein, calcium, potassium and vitamin C, and has a particularly good amino acid balance. Moreover, the potato is a very productive crop: it produces more food per unit area and time than wheat, rice or maize. One of the crop's assets is its adaptability – it can be grown in a wide variety of farming systems. The crop has a short and highly flexible vegetative cycle, and can be ready for harvest within 100 days of planting. It fits well with double-cropping and intercropping systems, is ecologically quite adaptable and can be grown as an off-season crop.

The potato is shielded from international shocks as, unlike major cereal commodities, it is sparingly traded in global markets. Only a fraction of total global production enters foreign trade; thus, potato prices in Kenya are determined by local demand and supply conditions, not by unreliable international markets. In addition, since the potato is not widely sold on major international commodity exchanges, the crop is not at risk from the ill-effects of speculative activity. The potato is therefore, a highly dependable food security crop that can help ease future turmoil in world food supply and demand. The potato is a highly recommended, nutrient-rich crop that can protect low-income countries from the risks of rising international food prices, while providing a valuable source of income for subsistence farm households.

The potato has tended to be a low priority crop in Kenya's agricultural development policies, despite its importance as a staple food and its potential contribution to combating hunger, poverty and

unemployment. Numerous constraints have limited potato productivity and profitability, and actual yields are well below those which could be reached by using the available technology and adopting appropriate post-harvest practices. As a result, growers get poor returns and yields are insufficient to make potatoes available for use as seed or for consumption in urban markets.

Recent initiatives undertaken by the Kenyan Government, stakeholders and development partners to overcome the constraints include: introduction of rapid seed multiplication technologies; training in alternative seed production methods; private sector involvement in basic seed production; and the formation of the National Potato Council of Kenya (NPCK), a multi-stakeholder and public-private partnership (PPP) platform. A growers' association – the Kenya National Potato Farmers Association (KENAPOFA) – is also in place, but needs to be strengthened.

Seed systems and variety development

High-quality planting material, considered fundamental for achieving the subsector's potential, accounts for less than 5 percent of total seed used, and over 95 percent of farmers depend on common, disease-infested seed. The limited use of high-quality planting material is attributed to a variety of factors, including: growers' limited knowledge of the availability of such seed and its productivity and economic benefits; the limited production and distribution of certified, "clean" seed; and its relatively high cost versus the limited resources and absence of credit available to the small producers who make up the vast majority of the subsector's farmers. High priority interventions are required to enhance the seed system and improve varietal development, including:

- installation of irrigation facilities at key farm locations charged with producing breeder's and basic seed;
- development of a coherent strategy to produce the quantities of seed required to meet the estimated demand for high-quality planting material, taking into account everything from improved estimates of actual area cultivated and yields from current ware production to gaining access to the land needed to produce certified seed through a combination of land purchase, rental and outgrower schemes;

- improvement of quality control in the laboratories dedicated to germplasm clean-up and conservation;
- seed quality assurance;
- in-house quality testing to ensure that seed is free from pests and diseases; and
- greater investment in potato research and development.

Investment is necessary in the following areas:

- Breeding – to develop new varieties
- Pathology – to improve disease and pest control
- Agronomy and agricultural engineering for irrigation – to increase production
- Agricultural engineering and food technology – to improve storability of seed and ware potatoes
- Research on low-cost disease diagnosis and germplasm conservation – to develop biotechnology
- Socio-economics – to develop marketing

The accreditation or authorization of private enterprises to engage in certified seed production can also facilitate further increases in the production of high-quality planting material. The introduction of specialized varieties is also of growing interest, for example, varieties appropriate for processing or suitable for lowland cultivation.

Ware potato production

Potato production takes place mainly under rainfed conditions and is concentrated at altitudes above 1 500 m. Most farmers use basic production and post-harvest management practices, resulting in small quantities and poor quality of marketed potatoes. Average yields are less than 10 tonnes/ha (FAOSTAT). This poor performance is the result of several challenges facing the subsector, including:

- low-quality seed;
- limited use of inputs use; and
- prevalence of pests and diseases.

Potato marketing and processing

Potato marketing channels are poorly articulated and growers obtain low returns for a variety of reasons, including:

- perishability of tubers dug before their skins have hardened;
- lack of adequate storage facilities;
- poor access roads;

- poor infrastructure in public wholesale and retail markets;
- lack of implementation of quality standards;
- inadequate access to market information; and
- weak farmers' organizations.

The resulting logistical challenges associated with securing a reliable and consistent supply of good-quality raw material also hinder the generation of added value in the potato marketing chain.

Policy, legal and regulatory framework

While various acts of parliament, legal notices and subsector strategy documents and plans exist to govern production, marketing and processing of potatoes in Kenya, their implementation is a considerable challenge. This has been the case with the Root and Tuber Crops draft policy, the potato strategy and the Seed Potato Master Plan. Documents must be reviewed and updated in order to meet current national aspirations, international laws and guidelines. Certain regulations and legal notices have been partially implemented, for example, Legal Notice No. 44 (2005) and Legal Notice No. 113 (2008).

Policy recommendations

Sustaining the growth of the potato subsector to meet the challenges of diversification depends on policy reforms to transform the potato subsector from its current status of semi-commercialized, uncompetitive and uneven productivity, characterized by low and declining average yields (< 10 tonnes/ha), low agribusiness (< 10 percent), moderate employment (3.3 million), moderate income (KES 40 billion [USD 362 million] – at consumer prices) and low diversification, to a robust, competitive and self-regulating industry, characterized by high yields (> 25 tonnes/ha), high agribusiness (> 80 percent), high employment (6.6 million), high income (KES 150 billion [USD 1.7 billion]), and vertical and horizontal diversification. The specific recommendations are outlined below.

Ware potato production

Farm-level:

- Promote use of improved-quality (i.e. pest- and disease-free) seed – this is top priority.
- Take complementary initiatives to improve soil and water management practices in order

to increase potato productivity and, where feasible, assist growers to invest in irrigation infrastructure to expand output, raise average yields and reduce the climatic risks associated with small-scale, rainfed potato cultivation.

- Facilitate access to affordable credit and financial services for small farmers.

Market-level:

- Complement farm-level initiatives with a systematic, multi-year programme to construct all-weather, rural feeder roads to link major potato-producing counties with urban markets and with aggressive enforcement of existing regulations governing the use of 110-kg bags.
- Strengthen smallholder organizations to improve farmers' bargaining power and to enhance production and the transmission of marketing information.
- Foster widespread use by farmers of the expanded ICT (information and communications technology) network, such as cell phones and the Internet.
- Promote the pricing and sale of potatoes by grade and variety, bringing into play high-profile urban retailers.
- Install a basic marketing infrastructure, including covered areas, paved central squares and overnight storage facilities in open-air public markets.

Consumer-level:

- Conduct a major campaign to emphasize the cooking of potatoes with their skins – through initiatives such as recipe promotion, regional gastronomic events and cooking classes in secondary schools – to ensure that the much heralded nutritional benefits of the potato are better understood by the general public and fully taken advantage of in daily eating habits, particularly in the case of school-aged children.
- Focus efforts to foster greater production and use of ware potatoes.
- Intensify coordination between a cross-section of public, private, international and development organizations to ensure more coherent and consistent reporting on subsector developments – from information on actual area harvested, yields and prices for ware potatoes and seed to ongoing projects or proposed new programmes.
- Prioritize programmes in order to benefit the large numbers of existing growers and urban consumers: begin in existing major production

zones and use principal marketing channels to link growing areas with urban consumption centres, promoting potatoes for sale, processing and use in fresh form.

Seed potato production

- Update the Seed and Plant Varieties Act (Cap. 326) to keep up with new initiatives and demands for increased production of quality seed potatoes that are vital for subsector development.
- Streamline the inspection process and enable certification of *in vitro* plantlets and mini-tubers.
- Recognize and develop standards for quality declared seed and planting material.
- Allow marketing of seed potatoes in smaller quantities (10 or 20 kg) to encourage widespread use of good-quality seed.
- Adopt policies to facilitate characterization, indexing and release of farmer-preferred varieties in order to jump-start production of certified seeds of those cultivars.
- Enhance public-private partnerships for the regulation and control of diseases including authorization and accreditation of greater participation of the private sector in seed inspection and regulation.
- Develop and promote more effective seed potato distribution systems to ensure availability and access for farmers.
- Encourage existing and new financial institutions to develop appropriate financial packages for seed growers.
- Establish strategic reserves of seed potatoes through promotion of cold storage, increased

farm-level storage and *in vitro* conservation of plantlets.

- Create and strengthen linkages and networking among potato research institutes, extension organizations and seed producers (public and private) through a subsector platform within the NPCK to share information such as research results, ongoing planning, solutions and the way forward for the seed subsector.

Cross-cutting issues

- Raise awareness among policymakers of the subsector's potential for improving incomes, nutritional benefits, processing options and food security and of its contribution towards achieving Vision 2030 and Millennium Development Goals (MDG).
- Engage policymakers at national, county and municipal level in the implementation of the initiatives outlined above while encouraging and promoting greater private sector involvement in improved production and use of the potato.
- Strengthen the NPCK by developing mechanisms and legislative support to make the subsector financially sustainable and by facilitating its integration into existing institutions at different levels of governance and within the subsector.
- Increase national government funding and support of the potato subsector to enable implementation of the recommended initiatives, including consistent funding of a core national potato research and development programme.
- Foster greater investment by the private sector in potato-related business initiatives.

1. Introduction

The potato as a strategic crop for diversification and its potential as a source of food security, nutrition and income generation



Potato and meat stew

Among the chief goals of agricultural sector policies in sub-Saharan Africa are to increase the productivity and incomes of smallholder farmers; to enhance food security and equity; to stabilize agricultural output through greater use of irrigation; and to promote commercialization and intensification of production, appropriate and participatory policy formulation and environmental sustainability. In most sub-Saharan African countries, however, development of the agricultural sector continues to be constrained by weak vertical integration, inadequate institutions and support services, and the concentration of output in a narrow range of agricultural products for export or domestic consumption.

Agricultural diversification is a strategy for enhancing the welfare of low-income rural households. Its positive effects include improvement of food security, mitigation of risk, employment generation and conservation of biodiversity. New opportunities for crop diversification are emerging,

especially for enterprising and progressive farmers. Rising incomes and standards of living, rapid urbanization, and changing lifestyles, tastes and preferences – in both industrialized and developing countries – have spurred significant changes in domestic and international demand for food. Trade liberalization and development of transport infrastructure are improving access to new and distant markets.

Diversification strategies promote greater flexibility among producers, which allows them to take advantage of opportunities created by evolving national and international market conditions. They seek to enable farmers to produce different crops (“horizontal diversification”) or engage in different value-addition activities (“vertical diversification”). As diversified production improves dietary diversity or introduces new processed food products, it can enhance the nutritional balance of people’s diet and, in doing so, help improve their health and earning capacity.

However, sub-Saharan Africa’s farmers have largely failed to reap the benefits of diversification. Very few farm units actually generate significant income through the adoption of yield-increasing technology or improved processing and marketing practices. Similarly, instead of diversifying production horizontally or between regions, farm units or regions often concentrate their efforts on only a few crops year after year.

1.1 Crop diversification in Kenya

Kenya's agricultural sector is the mainstay of the national economy and provides the basis for the development of other sectors. It accounts for 26 percent of gross domestic product (GDP) and through linkages with agro-based and associated industries, contributes an estimated additional 27 percent to GDP. Growth of 1 percent in the agricultural sector generates a corresponding rise in GDP estimated at 1.6 percent. The agricultural sector employs more than 80 percent of the total labour force and provides 75 percent of industrial raw materials. Primary agro-based products constitute more than 50 percent of the country's total exports; the value of agricultural exports accounts for 64 percent of total exports.

About 80 percent of Kenya's population lives in rural areas, with three-quarters of them engaged in agricultural activities. The sector is dominated by smallholders, who account for about 75 percent of total output. Agricultural production is dominated by a narrow range of commodities, including coffee, tea, dairy, maize, wheat and horticultural crops. Cultivation of these crops is the source of livelihood for over 85 percent of the population, with coffee and tea alone providing 45 percent of total wage employment in the sector. Despite their high export potential, fresh produce shipments abroad account for only 3 percent of the level of value addition in the agricultural sector. The continued concentration of output suggests that Kenya has yet to fully exploit its potential to diversify production towards value-added non-traditional commodities. Such diversification and greater vertical integration could help improve and stabilize agricultural output, productivity and income as well as enhance food insecurity and reduce overreliance on a few crops for domestic food requirements and exports (UNDP, 2006).

In Kenya, agricultural produce is commonly marketed with minimum added value, which reduces farmers' potential revenue and limits the creation of associated employment opportunities for wage earners. Very little effort has been made to utilize storage and agroprocessing opportunities to increase the value of agricultural produce and enhance income-earning potential. These practices persist despite a series of measures endorsed by the Agricultural Sector Development Strategy (2010–2020), including:

- provision of incentives for establishing agro-industries in rural areas;
- research focused on value-addition activities, such as processing, storage and packaging of agricultural produce;
- promotion of partnerships between smallholders and agribusiness;
- improvements in infrastructure (e.g. rural access roads, rural electrification, water and telecommunications); and
- training for farmers and farmer institutions in value addition.

However, agricultural diversification in Kenya faces many challenges which hinder the realization of its potential. These challenges include:

- low yields and poor-quality tubers that drive up the cost of raw materials and reduce conversion rates;
- poor, outdated technology that results in inefficient production of high-value products;
- WTO (World Trade Organization) regulations that increase the cost of imported seeds and planting material;
- the limited capacity of national quality assurance bodies to ensure compliance with international standards; and
- non-tariff barriers to trade, such as phytosanitary restrictions.

The lack of diversification in Kenyan diets aggravates the vulnerability of poor households. Maize is viewed as the anchor of the nation's food security. The dependence of a large proportion of the population on maize-based diets and the lack of policy focus on diversification of food availability at household level leaves many households vulnerable to volatility in the prices of maize and maize-based food products, and to the effects of unstable weather and unreliable marketing systems. Inadequate policy support for production of value addition and utilization of alternative food commodities leaves the country overly reliant on the vagaries of annual maize output and the vicissitudes of international commodity prices to make up any shortfall. Kenya's maize imports, which averaged 186 000 tonnes during the period 2000–08 (De Groote *et al.*, 2012) ballooned to 1.5 million tonnes in 2009 (FAOSTAT, 2012).

To address the above constraints, the Government of Kenya has focused recently on crop diversification and value addition in agriculture. Key areas of policy

concern and strategy, which are highlighted in the Vision 2030 (GoK, 2007) and ASDS (GoK, 2010a) documents, include catalyzing enhanced agricultural productivity, food security and income growth. Crop diversification is seen as a strategy that will help dampen food price inflation, by facilitating the greater availability of a broader mix of nutritious and versatile staple foods that are much less susceptible to volatile international markets, changing weather patterns and political machinations.

The potato has all these characteristics. Already widely grown and eaten in Kenya, the tuber is a highly suitable candidate for inclusion in any crop diversification strategy. The Comprehensive African Agricultural Development Programme (CAADP) says the growth and development of sub-Saharan countries will be achieved mainly by identifying the subsectors that have the greatest potential to drive growth and reduce poverty. That means exploiting the potential of commodities that have an existing production base as well as a large and growing demand in the region.

1.2 Importance of the potato

Global potato production was 324 million tonnes in 2012 (FAOSTAT, accessed July 2012) and is projected to reach more than 400 million tonnes by 2020 (Scott *et al.*, 2000). Potatoes are grown in more than 100 countries. China is currently the world's largest potato producer, accounting for more than 20 percent of global production (Scott and Suarez, 2012a). Production is expanding strongly in many countries of the developing world, which now accounts for more than half of the global harvest (Scott, 2011; Scott and Suarez, 2012b, 2012c). The rapid growth in potato production witnessed in developing countries – particularly in Asia and Africa – often surpasses that of other major food crops, such as maize and wheat.

The potato is highly efficient at converting seed, land and water into high-quality food with wide consumer acceptance (FAO, 2009). Many of the poorest producers in developing countries, and most undernourished households, value the potato because it produces large quantities of dietary energy and maintains relatively stable yields under conditions in which other crops might fail. Those characteristics make the potato suitable for cultivation in many low-income developing countries, where arable land is limited and unemployed labour is abundant.

Importance of the potato

- Potatoes are rich in micronutrients, especially vitamin C – eaten with its skin, a single medium-sized potato of 150 g provides nearly half the daily adult requirement (100 mg).
- The potato is a moderate source of iron, and its high vitamin C content promotes iron absorption. It is also a good source of vitamins B1, B3 and B6 and minerals, such as potassium, phosphorus and magnesium, and contains folate, pantothenic acid and riboflavin (Woolfe 1987).
- Potatoes contain dietary antioxidants, which may play a part in preventing diseases related to ageing, and dietary fibre, which benefits health.

Unlike cereals, the potato is not massively traded in global commodity markets. Owing to the potato's bulkiness and perishability, and its low value in relation to weight, only a fraction (estimated at 5 percent) of world output enters foreign trade. As a result, potato prices are usually determined by local supply and demand conditions. The potato is, therefore, a strategic food security crop that can help cushion low-income consumers during periods of turmoil in world commodity markets. Since 2008, when the United Nations celebrated the International Year of the Potato, the crop has assumed a new status and is now being promoted as an important contributor to eradicating global hunger and poverty.

The potato can make a significant contribution to the food and nutrition security of Kenya. Among root and tuber crops, it has the highest protein content (around 2.1 percent on a freshweight basis). In addition, the protein is of fairly high quality, with an amino acid pattern that is well matched to human requirements. The potato is also a good source of vitamins, potassium and fibre (Woolfe, 1987). It provides about one-third of the recommended daily allowance of vitamin C (provided it is cooked and preferably eaten with the skins). Contrary to the misconception that potatoes are fattening and low in food value, the ratio of protein to carbohydrates is higher in the potato than in many cereals. In fact, the nutritive value of the potato is higher than that of maize, beans, soybean, peas and wheat. It is also an excellent “pro-poor” crop owing to its high yield potential, especially in Kenya where the fragmentation of farms has led to small-scale producers accounting for more than 80 percent of all agricultural producers. In terms of protein, the potato produces twice as much protein per hectare per day as dry beans.

2. The potato subsector

The importance of potatoes and the current status of the potato subsector in Kenya



Potato plants in aeroponic system ready for harvesting

2.1 The potato and Kenya's economy

The potato is Kenya's most important food crop after maize, plantains and wheat (FAOSTAT, 2012) and is an increasingly important source of cash for the country's low-income small-scale farmers. Since the potato is a highly labour-intensive crop, it generates considerable employment in production, marketing and processing. An estimated 800 000 farmers grow potatoes, while an estimated 2.5 million people are employed in the potato subsector as market agents, transporters, processors, vendors and exporters.

2.2 Production characteristics

Production systems

In Kenya, potatoes are usually grown on small family farms of less than 2 ha, where total area planted to potatoes is typically less than 1 ha (Gildemacher *et al.*, 2009a; Obare *et al.*, 2010). In a few counties, such as Bomet, Nyandarua and Narok, a small number of large, commercial growers cultivate several hectares or more of potatoes.

Most potatoes are grown in monoculture. However, some farmers – especially very small-scale growers – intercrop potatoes with other food crops such as maize and beans. Given their limited resources, many of these farmers grow potatoes season after season on the same plot, without crop rotations. Others grow potatoes in rotation with maize, wheat or barley. Crop husbandry on many

farms is rudimentary, with barley, beans, coffee, maize, onions, pyrethrum, tea, tomatoes and wheat all competing with the potato for scarce household resources. More than 90 percent of all potato farmers use their own, farm-saved seed tubers. Growers generally do not rejuvenate their seed stocks on a regular basis (Gildemacher *et al.*, 2009a). The use of botanical or “true potato seed” for planting potatoes is rare, at best. “Quality declared seed” (QDS) is still not available despite farmers reportedly being able to produce “clean seeds” on a regular basis.

More than 60 potato varieties are grown in Kenya, but relatively few are widely distributed. The dominance of certain varieties shifts with time, and a once popular and widely grown variety can be abandoned by farmers within a short period of time. For example, in the 1990s, a farmers' variety, ‘Nyayo’, was among the mostly widely cultivated varieties in the country. Today, it has been almost completely discarded, replaced by ‘Zangi’ (another farmers' variety) and ‘Tigoni’ (an officially released variety), mainly because of market preferences. The predominance of certain varieties also varies from region to region. For example, ‘Dutch Robijn’ is the preferred variety in Bomet, while in the Meru region it is ‘Asante’.

Ware potatoes are usually sold immediately after harvest; storage for future sale is seldom practised. Smallholder potato farmers own little machinery and mechanization is rarely applied except for land preparation.

Potato production practices remain suboptimal, in part because agricultural support services – such as extension and production credit – are minimal and market signals, in the form “better prices for better quality tubers”, are often distorted. As a result, good crop management, involving the appropriate and efficient use of inputs, such as good-quality seed, is seldom practised. Farmers rarely keep written records of production or marketing practices, so documenting farm operations as part of traceability and business monitoring is usually not possible. Most farmers do not use protective gear when handling

pesticides. Good agricultural practices (GAPs) for potatoes have yet to be developed.

Nearly all potato production occurs under rainfed conditions. The crop is generally planted twice a year, during the April–June long rains and the October–December short rains. In some areas, rainfall patterns are different – in the Meru region, for example, the highest rainfall is during October/December, which is considered the main potato-growing season, while the Kericho and Kisi regions receive rains as early as January and a second crop can be planted in July. In recent years, variability in the amounts, onset and duration of rainfall has become more pronounced, with some observers attributing the variations to climate change. Droughts, flooding and increases in temperature are projected to become more intense in the coming years.

The major potato diseases include late blight (*Phytophthora infestans*), bacterial wilt (*Ralstonia solanacearum*) and viral diseases such as potato leaf roll and potato virus Y (Gildemacher *et al.*, 2009a). Pests of significance include aphids, potato tuber moth, cut worms and leafminers. Climate change is expected to cause an increase in the incidence of these pests and diseases primarily due to shifts in rainfall and temperature patterns favouring their propagation and the continued expansion of production to lowland growing areas.

Farmers often harvest potatoes while the crop is still immature, i.e. before the tuber's skin has hardened sufficiently. This reduces storage quality, shortens potential storage time, and increases the risk of damage and losses during transportation and handling.

Farmers usually harvest their crops after identifying buyers. In most cases these are travelling brokers, who rarely arrange to buy potatoes from farmers until they have secured orders from prospective buyers. Given these established practices, few farmers engage in on-farm storage of ware potatoes for future sale (Kiruma *et al.*, 2004). Storage of ware potatoes in factories, restaurants and hotels is generally for short periods prior to processing. Some farmers store potatoes in bags in their houses or in multipurpose stores, but only a few use improved storage. One private company has recently constructed a state-of-the-art processing facility with modern cold storage for ware potatoes. Although sprout suppressants could be used to prolong the shelf-life of the ware potato tubers, this is not common practice.

Potato production system in Kenya

- Farmers' varietal preferences are constantly shifting with time as once popular varieties are completely abandoned by growers.
- Ware 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.
- Most potatoes are harvested when the tubers are immature.
- On-farm seed storage takes place under rustic conditions and employs natural ventilation.
- There is no significant production of certified seed potatoes in the arid and semi-arid land (ASAL) regions.
- There is a mismatch between the varieties that farmers prefer and those multiplied in certified seed programmes.

On-farm seed storage is generally done in basic stores that employ natural ventilation. Seed tubers are stored in heaps in the house or outside in pits to enhance sprouting. Few farmers use improved Diffused Light Storage (DLS) and the use of cold stores for seed is practised only at the Kenya Agricultural Research Institute in Tigoni (KARI-Tigoni) and at the Agricultural Development Corporation (ADC) complex in Molo. Breaking dormancy remains a major challenge for small farmers who plant two crops a year. Many varieties with long dormancy have been abandoned by farmers in favour of varieties with short dormancy periods.

Production and yield trends

The bulk of the potato crop is cultivated at between 1 500 and 3 000 m above sea level. Production is currently concentrated in three of Kenya's eight administrative provinces (GoK, 2011): Rift Valley, Central Province and Eastern Province. National statistics for 2009, calculated on the basis of the estimated number of 110 kg bags of potatoes produced, are shown in Table 1. Central Province was the largest potato producer with a harvest of about 220 000 tonnes (37.7 percent of total production), followed by Rift Valley Province (157 000 tonnes or 27 percent) and Eastern Province (113 000 tonnes or 19 percent). The farmgate value of production was estimated to be KES 6.3 billion [USD 117 million].

It should be noted that the level of potato production in Kenya is disputed. The figures reported here (Table 1) are 20 percent higher than the 480 000 tonnes/year indicated by FAOSTAT for

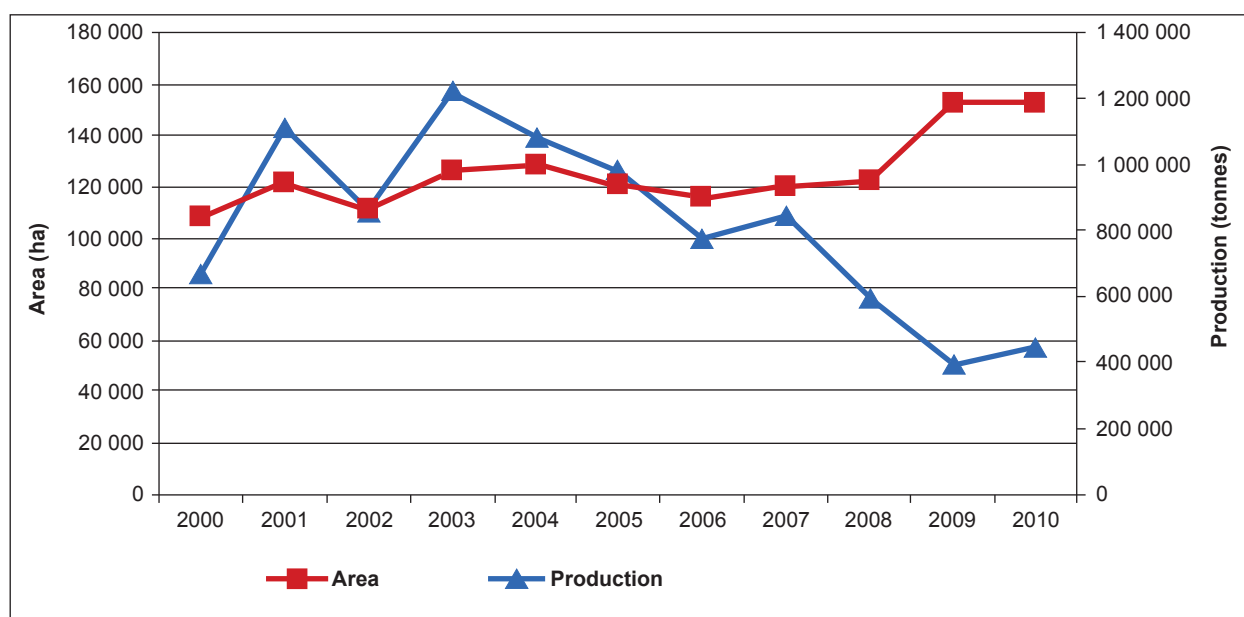
TABLE 1

Potato production by province compared with other major crops in Kenya, 2009

Crop	Indicator	Rift Valley	Nyanza	Eastern	Western	Coast	Central	Northeastern	Nairobi	Total
Maize	Crop area (ha)	644 895	262 453	462 401	225 302	129 379	157 063	2 525	1 053	1 885 071
	Bags (90 kg)	13 225 039	3 711 215	3 903 141	4 163 878	1 079 383	1 047 879	5 520	6 420	27 142 475
	Yields (bag/ha)	20.5	14.1	8.4	18.5	8.3	6.7	2.2	6.1	14.4
Wheat	Crop area (ha)	103 455	0	14 160	270	0	13 709	0	0	131 594
	Bags (90 kg)	1 509 961	0	552 495	7 050	0	367 172	0	0	2 436 678
	Yields (bag/ha)	15	0	39	26	0	27	0	0	19
Beans	Crop area (ha)	200 263	146 954	286 861	216 343	1 984	107 749	24	527	960 705
	Bags (90 kg)	1 019 109	1 081 360	1 914 515	689 397	13 844	450 664	141	1 666	5 170 696
	Yields (bag/ha)	5	7	7	3	7	4	6	3	5
Rice	Crop area (ha)	0	6 411	0	1 132	1 571	12 635	80	0	21 829
	Bags (50 kg)	0	384 660	0	16 326	15 389	424 106	3 556	0	844 036
	Yields (bag/ha)	0	60	0	14	10	34	44	0	39
Potatoes	Crop area (ha)	222 620	97 320	144 774	108 313	657	141 736	5	687	716 112
	Bags (110 kg)	1 429 217	397 092	1 029 232	435 893	3 285	1 992 930	10	3 492	5 291 151
	Yields (bag/ha)	6	4	7	4	5	14	2	0	7

Source: Economic Review of Agriculture, 2010

FIGURE 1

Potato production and area harvested in Kenya, 2000–2010

Source: FAOSTAT

the years 2008–2010 (Figure 1) and 36 percent lower than the total imputed by informed observers who argue that the average sack of potatoes weighs closer to 150 kg, despite government regulations mandating the use of 110-kg bags. Major inconsistencies in basic information on the

potato subsector hamper efforts to plan and monitor initiatives to improve production and utilization.

Potatoes are produced mainly in 14 counties: Bomet, Bungoma, Elgeyo-Marakwet, Kiambu, Laikipia, Meru, Nakuru, Narok, Nyandarua, Nyeri, Taita-Taveta, Trans-Nzoia, Uasin Gishu and West

Pokot. Major growing districts include Baringo, Bomet, Bungoma, Elgeyo Marakwet, Embu, Kiambu, Kirinyaga, Kisii, Kericho, Laikipia, Machakos, Meru, Muranga, Nandi, Nakuru, Narok, Nyamira, Nyandarua, Nyeri, Taita Taveta, Trans Nzoia, Uasin Gishu and West Pokot.

There is currently no significant production of the potato in arid and semi-arid land (ASAL) regions.

Figure 1 shows that the harvested area of potatoes increased by almost 50 percent between 2000 and 2009: from 108 516 to 153 114 ha. A marginal reduction to 152 994 ha was registered in 2010. Over the period 2000–10, potato production fluctuated considerably: output peaked at 1.2 million tonnes in 2003 before collapsing to some 400 000 tonnes per year in 2009.

Average potato yields appear to have fallen considerably. According to FAOSTAT, they dropped from 9.7 tonnes/ha in 2003 to 2.6 tonnes/ha in 2009 (Figure 2). Those yields are well below the average for Africa as a whole (10.8 tonnes/ha), and a number of recent research papers suggest that actual productivity may be seriously underestimated (Gildemacher *et al.*, 2009a; Obare *et al.*, 2010). These and other inconsistencies in national potato statistics – both among Kenyan sources (see Kirumba *et al.*, 2004) and between official government data and the figures reported by FAO – need to be addressed in order to facilitate subsector benchmarking, improve monitoring and evaluation and reduce the transaction costs associated with assessing private sector investment opportunities.

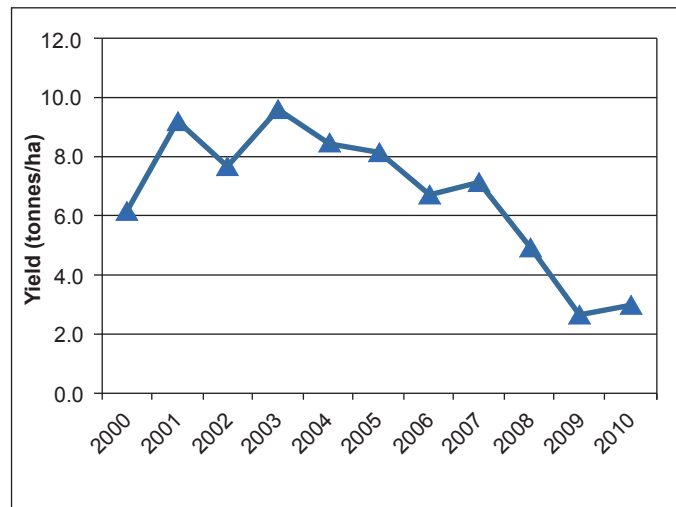
Competitiveness

Market-oriented potato farmers who follow technical GAP recommendations – including the use of clean or certified seed – can achieve yields of up to 50 tonnes/ha. Using optimal potato cultivation practices, farmers can earn up to USD 3 434.5 (KES 288 500) per hectare for a return of USD 8.4 (KES 704) per family labour day – that is about 4 times more than the average wage of a casual labourer.

Women and men are nearly equally involved in potato operations. Some tasks are of a heavy duty nature and thus require young men. Therefore, in addition to being pro-poor and gender-balanced, Kenya's potato enterprise often creates employment opportunities for underemployed youth.

FIGURE 2

Average potato yields in Kenya, 2000–2010



Source: FAOSTAT

2.3 Breeding and seed systems

Breeding: adaptive research, varietal release and basic seed production

In Kenya, development of new potato varieties was only recently reinitiated with the reintroduction of cross-breeding activities in the national potato programme. For many years superior clones developed for tropical Africa were imported from the international gene bank operated by the International Potato Center (CIP) in Lima, Peru. Recently, national programme scientists have undertaken adaptive research in which clones, particularly those with tolerance to late blight and viruses, are exposed to a variety of stresses. The successful ones are then officially released, bulked and certified for regular use. These national performance trials are coordinated by Kenya's Plant Health Inspection Services (KEPHIS).

Kenya's potato breeding programme, which is undertaken mainly by KARI-Tigoni in cooperation with CIP, focuses on screening varieties for tolerance to biotic stresses. A number of innovative and efficient techniques are being used to produce pre-basic and basic seeds, including clonal seed selection, tissue culture and production of mini-tubers from aeroponics. Aeroponics represents a shift from the previous practice of producing mini-tubers under glasshouse or screenhouse conditions directly from *in vitro* plantlets and stem

cuttings. Despite improvements in technology, the clonal system of seed production still accounts for more than 90 percent of all the basic seed tubers produced at KARI-Tigoni.

Between 2000 and 2011, Kenya's potato programme released seven new potato varieties (Table 2). However, it is estimated that these varieties are currently planted over less than 10 percent of the total potato area in the country. The reasons for the low uptake are unclear, but may include the limited availability of seed tubers and other agronomic or consumer-driven factors.

Since most adaptive potato research in Kenya has aimed at improved tolerance to biotic stresses, little has been done to develop varieties with improved tolerance to abiotic stresses, especially drought and poor soils. National potato production has therefore tended to be pushed towards the wetter areas, a trend which may have contributed to deforestation and climate change.

Seed systems: multiplication, distribution, packaging and storage systems

Seed systems encompass both the ways in which the seed of new varieties is generated and the ways farmers produce, select, save and acquire seeds of established varieties. Three seed potato systems are currently operative in Kenya: formal, semi-formal and decentralized, farmer-based informal seed systems.

Formal seed system

This system, which is governed by laws and official guidelines, has evolved over the years from various projects and programmes funded by the Government and development partners. The guiding principles are to:

- produce, distribute and promote the use of certified seed, or seed that meets official physical and physiological standards; and
- establish a limited number of seed outlets that may be increased through, for example, public-private sector partnerships.

The formal seed potato system links agencies for basic seed production, certification and certified seed production. Basic seed is produced largely by KARI-Tigoni and a few private sector companies, including Genetic Technologies International Limited (GTIL) and Kisima Farm. Certified seed is produced by the Agricultural Development Corporation (ADC), a government parastatal, the KARI seed unit in sanitary quality. This material is the progeny of basic seed and its production is handled so as to maintain specific genetic identity and purity according to the standards prescribed for certified potatoes. It may also be the progeny of certified seed, provided that reproduction does not exceed three generations beyond the basic seed stage.

Certified seed is obtained from the multiplication of basic seed under the stringent supervision of

TABLE 2

Characteristics of the potato varieties recently released in Kenya, 2006–2010

Variety	Skin colour	Shape	Maturity Period ¹	Yield ²	Year of release
Kenya Faulu ³	Red	Long oval	Late	High	2006
Kenya Karibu	Red	Round	Late	High	2006
Kenya Mavuno	White	Round	Late	High	2006
Kenya Mpya	White	Oval	Medium early	High	2010
Kenya Sifa	Red	Round	Late	High	2006
Kenya Sherekea	White	Round	Late	Very high	2010
Purple Gold	Purple	Round	Late	Medium	2010

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 tonnes/ha), medium (21–30 tonnes/ha), high (31–40 tonnes/ha) and very high (> 40 tonnes/ha).

³ No longer in production due to poor conservation strategies resulting in a loss for the potato programme.

Source: KARI-Tigoni Annual Reports

KEPHIS. It is the only seed potato that may be legally traded under Kenyan law. Although mainly produced by the public sector, production and sale of certified seed has become the focus of a number of recent private sector initiatives. Furthermore, there is a growing consensus in Kenya that the private sector has considerable potential to further expand its role in the production and sale of certified seed potatoes. Currently, marketing and distribution of certified seed takes place through Ojororok and private seed growers (e.g. Kisima Farm). Seed certification is currently carried out only by KEPHIS, although a bill currently before parliament may allow for the accreditation of private seed inspectors.

Semi-formal seed system (decentralized, farmer-based)

In this system, the quality of the seed produced is lower than that of certified seed but higher than that produced by the informal seed system. The semi-formal system produces two types of seed: “clean” and “positively selected”.

- **Clean seed.** Multiplied at farm level and not currently subject to inspection by KEPHIS. It originates from certified or basic seed and its production follows guidelines laid down in farmer training programmes conducted by organizations such as the MoA (Ministry of Agriculture), KARI, GIZ (German Agency for International Cooperation) and TOT (Training of Trainers). Most production guidelines used in the production of certified seed are also used to produce clean seed – only sample testing and supervision by KEPHIS is lacking. Negative selection is used to remove diseased and weak plants. Currently, the process of producing clean seed is technically backstopped by extension service providers from the MoA, KARI and NGOs (Non-governmental Organizations) and have been previously supported by a PSDA (Promotion of Private Sector Development in Agriculture)/CIP project. The seed multipliers receive training on how to produce clean seed from basic or certified seeds. The seed produced in this system is equivalent to what FAO refers to as “quality declared seed” (QDS) and only requires the development of protocols and legislation. Although Kenya has not yet legalized the use of QDS, other countries (e.g. United Republic of Tanzania) have already adopted the use of this type of seed for trade.

- **Positively selected seeds.** Positively selected seeds (PSS) are produced from ordinary or farmer-saved seeds through a process of selection carried out by farmers who have knowledge of good seed selection and management techniques. Multipliers of positively selected seeds receive training on how to select the best (disease-free) plants during the crop growth stage; these plants then become mother plants from which seeds for the next season are obtained. Production of this type of seed lacks stringent growing procedures and is not subject to inspection by KEPHIS. However, since this system helps to improve control of some of the major potato diseases found in farmers’ fields, it has the potential, if well managed, to significantly increase the yields of the majority of farmers growing potatoes (by up to 30 percent).

Informal seed system (farmer seed)

Informal seed consists of farmers’ own seed saved from the previous harvest or procured from neighbouring farms or rural markets. This seed has the lowest quality ranking. No guidelines are followed and no systematic seed selection is carried out. Since most farmers select small, leftover tubers for use as seed, and consume or sell the larger ones, yields are progressively lower in the following seasons.

More than 90 percent of the seed potatoes used in Kenya come from informal sources. Furthermore, informal sector seeds are often of very low quality, owing to years of degeneration. This type of seed is heavily infested with accumulated pests and diseases (especially bacterial wilt – *Ralstonia solanacearum* – and viral diseases). Not only does this seed produce very low yields (Gildemacher *et al.*, 2009a), but the buildup of pests and diseases after years of unbroken cycles contributes to the spread of diseases in other farmers’ fields.

Demand, supply, distribution and use of good-quality seed potatoes

Factors affecting the demand for, access to and use of improved seeds include:

- farmers’ perception of the potential for improvements in yield and quality;
- the cost of seed and other inputs (e.g. fertilizer and pesticides);

Factors affecting national seed potato demand in Kenya

- Area under potato production = 150 000 ha/year
- Seed rate = 2 tonnes/ha
- Levels of awareness and training
- Other factors

However, the recommended rate of seed renewal is once every four seasons, i.e. once in two years, and only about 10 percent of potato growers have shown any level of awareness or willingness to buy seed at the current price.

- relative prices for different crops;
- farmers' forecast of weather conditions;
- the effectiveness of promotional campaigns;
- the efficiency of the distribution system (and cost of reaching seed distribution and retail outlets); and
- the availability of credit.

Basic seed production increased from 9.6 tonnes in 2001 to almost 60 tonnes in 2008, while certified seed production increased almost tenfold (Table 3). This level of certified seed production is, however, far below the estimated 30 000 tonnes/year required to meet demand. Recent data indicate that less than 2 percent of seed potato requirements are met by certified seed. Scarcity of good-quality seed remains, therefore, a major constraint to improving potato productivity in Kenya.

2.4 Marketing and trade

Potatoes are currently marketed through informal value chains that add limited value to the final product. The sequence of transactions is dominated by a multiplicity of intermediaries, with very little cooperation or integration, and practically no standards or regulations. Mechanical damage, contamination, microbial infestation and spoilage are common.

Notwithstanding, market research has identified a series of well-defined marketing channels linking the major potato-producing areas with rural and urban markets (Figure 3).

Most ware potatoes are packaged in “extended bags”, which are supplied by traders and are capable of holding 130–280 kg of tubers. Farmers, their families and sometimes hired labourers pack and deliver the bags to assembly points located along feeder roads. Loading and offloading the bags is back-breaking work that adversely affects the health of handlers. The heavy sacks are frequently dropped or dragged, which results in damaged tubers. Additional marketing costs include:

- open air market space rentals;
- the cost of bags;
- sewing the bags;
- the wages of loaders and off-loaders; and
- operating capital.

TABLE 3

Production of various categories of seed in Kenya, 2000–2011

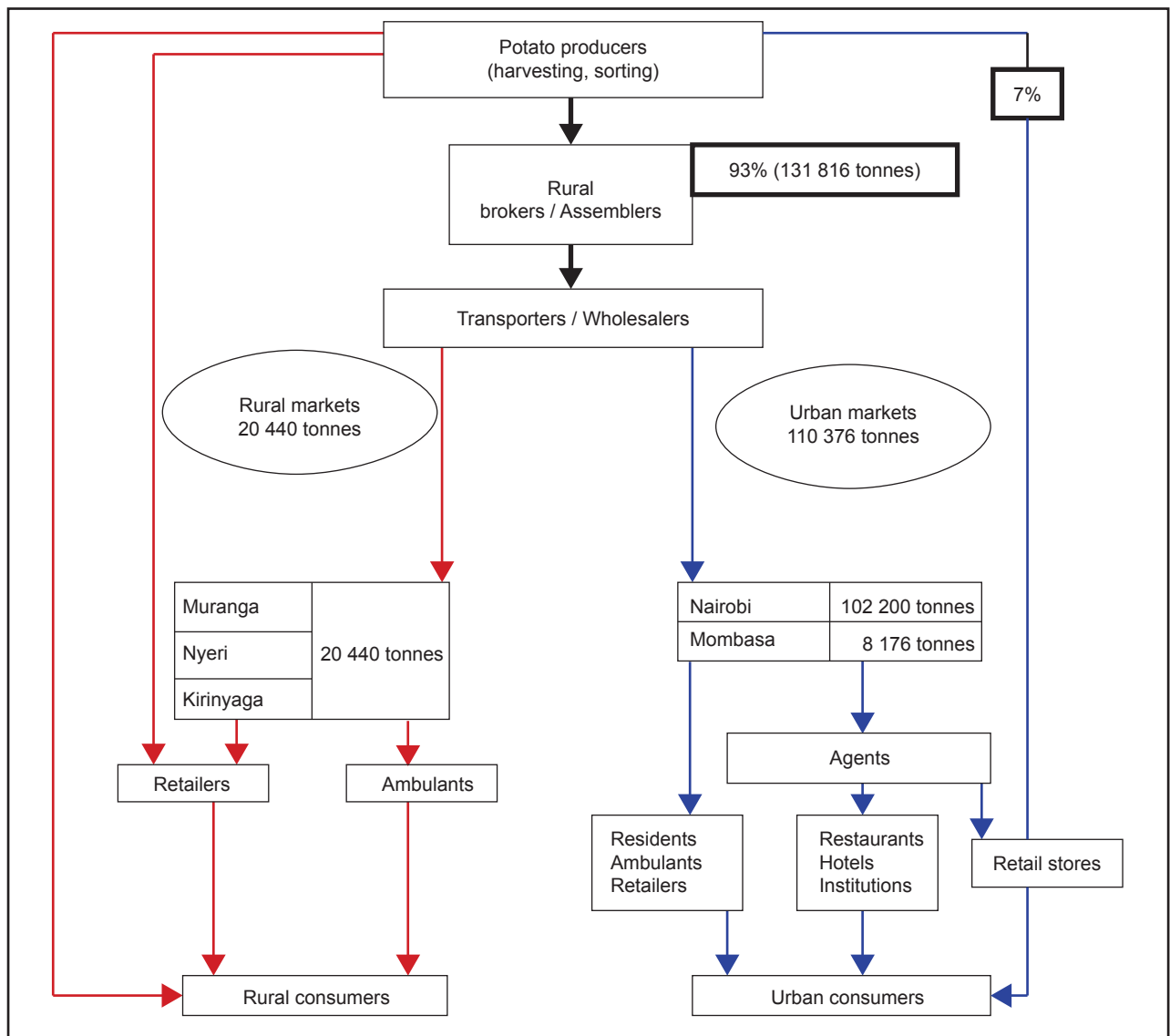
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Basic seed (tonnes)	37.3	24.6	16.2	8	21.9	35	60.9	77.5	59.2	64	84.3	100.8
Certified seed (tonnes)	52.8	119.8	22.3	54.3	103.3	67.3	235.3	483.2	n.a.	500	600	500
Clean seed¹ (tonnes)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1 200	1 500	1 500

¹ Estimates from various reports including the seed potato master plan.

Source: KARI-Tigoni Annual Reports

FIGURE 3

Marketing channels for potatoes harvested in Nyandarua County



Source: Kirumba *et al.*, 2004

Of the various expenses associated with rural assembly of potatoes, trucking charges are the biggest component owing to high fuel and maintenance costs and the deplorable condition of rural feeder roads (Kirumba *et al.*, 2004).

Potato producers face enormous challenges in terms of marketing logistics, physical infrastructure and market information. Given their small scale, geographic isolation and limited bargaining power, the vast majority of potato producers are negatively affected by high transaction costs, lack of price transparency, quality losses and shrinkage or waste (Kirumba *et al.*, 2004; Gildemacher *et al.*, 2009b).

Although standards for production and marketing of potatoes have been established through the Ministry of Agriculture’s Legal Notice No. 44 (2005), they have yet to be fully implemented. Marketing regulations require that potatoes be packaged in sisal or jute bags with a maximum capacity of 110 kg of potatoes and with netting at the top to allow for inspection of the tubers by prospective buyers and others. This regulation is reinforced by Legal Notice No. 113 in the form of adaptive by-laws of the Ministry of Local Government stipulating that no local authority may allow the sale of potatoes using extended (i.e. 130–280 kg) bags in any urban, municipal or city market.

In practice, the traditional extended bag remains the most common form of packing potatoes for transport and sale. Moreover, traders typically pay a price per bag corresponding to the standard weight (i.e. the requisite 110 kg), despite the fact that the bags often hold more.

Potatoes are normally transported in 3.5- to 7-tonne trucks that carry 50 bags of potatoes, although 12-tonne trucks with a capacity of up to 100 bags are sometimes used. Traders hire trucks either individually or jointly depending on their operating capital and the season. When quantities of potatoes are low or roads are impassable, transportation from the interior is usually by tractor, bicycle, donkey, handcart or motorcycle. There is no shipment of potatoes by rail.

Major markets for potatoes are located in large urban areas, such as Nairobi, Mombasa, Nakuru and Kisumu. Because potatoes are bulky and have a high moisture content, transport costs are high, and farmers closer to the major markets benefit more than those in remote areas. Most roads linking primary production market centres with intermediate centres are generally in poor condition.

Participants in the various marketing channels include a range of end-users:

- producers
- rural and urban consumers
- institutional buyers (e.g. hotels, restaurants, schools and hospitals)
- processors
- exporters

Some recent estimates indicate that only 2 percent of all traded potato produce is sold through supermarkets (Hoeffler and Maingi, 2005). Supermarkets are, nevertheless, becoming increasingly important outlets for processed potato products and a highly visible potential partner in efforts to modernize potato marketing and consumption.

Open air markets, small shops, kiosks and hawkers are currently the most important sales outlets for fresh tubers. Wholesale potato marketing in major consumption centres (e.g. Nairobi) tends to be dominated by relatively few traders. Trading arrangements are informal and the lack of market transparency suggests wholesalers occupy a strategic position in the value chain and have disproportionate influence over price formation and the associated marketing margins. At the same time,

the vast majority of municipal retailers handle very small volumes that push up their marketing costs, thereby increasing the price spread between the farmgate and urban consumers.

There is little use of information and communications technologies (ICTs) in the potato subsector. Communication in potato marketing mainly entails mobile phone calls between major urban centres. Traders communicate constantly with other middlemen about prices and volumes sold and negotiate financial arrangements before shipments are made. Some market information is transmitted via radio broadcasts. Where communication networks are poor, word of mouth is used by farmers, brokers and traders for market updates. The Government has recently invested in an extensive national fibre optic cable network, which is expected to improve Internet connectivity and lower the cost of accessing information online.

Potatoes grown in Kenya are destined almost entirely for the domestic market. There are, however, negligible exports of ware potatoes to Seychelles. There is also some informal, cross-border trade with the United Republic of Tanzania, the Sudan and Uganda. Such informal trade is largely opportunistic and typically takes place during short-term, seasonal windows. Small quantities of processed potato products (e.g. crisps, chevra and chevda) are exported to the United Kingdom and the United States of America. Some processed potato products are imported from South Africa, and frozen French fries are imported from European countries such as Ireland. At present, therefore, potatoes cannot be considered a foreign exchange earner for the country, although domestic production saves foreign exchange by reducing the need for imported food.

Kenya does not export certified seed, although requests have been received from countries, such as Burundi, Eritrea and the United Republic of Tanzania. An insignificant small volume of mini-tubers has been shipped to neighbouring countries, such as Rwanda, Somalia, Uganda and the United Republic of Tanzania.

An important recent development in the potato industry is the signing of an agreement between the Kenya Plant Health Inspectorate Services (KEPHIS) and the Netherlands Ministry of Economic Affairs, Agriculture and Innovation aimed at improving the quality of seed potatoes available for purchase in Kenya. Under this arrangement, the Netherlands Government and KEPHIS are expected to facilitate

private sector exports of seed potatoes from the Netherlands to Kenya. However, the agreement has generated controversy: some local potato industry experts argue that imports of seed potatoes for direct planting by farmers are likely to result in the introduction of diseases, such as *Dichaya* spp. and late blight mating type 2, which have to date not been reported in Kenya. The experts recommend that specific measures and protocols, informed by a thorough pest risk analysis and economic analysis, be put in place to ensure effective disease and pest surveillance and control. They also recommend capacity-building to strengthen the phytosanitary and regulatory facilities of the relevant Kenyan institutions.

2.5 Consumption, utilization and demand

Based on 2005 production and population data, annual average per capita consumption of potatoes in Kenya is about 29.6 kg. This is relatively low compared with Europe (87.8 kg) but double the average for all of Africa (13.9 kg). Potatoes are consumed boiled, fried, mashed or in stews. Urban residents are the country's main consumers and the reason for the soaring demand for ware potatoes and processed products, such as chips and crisps in restaurants and bars (Kirumba *et al.*, 2004; Tesfaye *et al.*, 2010). However, whether consumption is increasing due to massive growth of the urban population, or is a reflection of per capita increases, is less clear. Fresh consumption is common in those rural areas where potatoes are grown.

Processing is currently limited to the production of snack foods, such as crisps and chevera. At retail level, potatoes are mainly prepared and consumed as chips in restaurants, bars and takeaway outlets in Kenya's major urban centres (Teskaye *et al.*, 2010). Responding to consumer demand for quality processed products, some 40 local processors produce potato crisps and several large companies produce frozen potato chips for sale in leading supermarkets and some hotels. However, the limited available data suggest that the volumes of raw material these industrial processors handle are fairly minor compared with the quantities of fresh potatoes peeled and fried by bars and restaurants. Those utilization patterns are consistent with other developing countries (Scott and Zelada, 2011), given the low cost of labour, the high price of frozen potato products and the meagre incomes of the vast majority of urban consumers.

Packaging of potatoes is poorly developed except in the case of crisps and frozen chips. Small quantities of fresh potatoes are packaged and sold in net bags in some markets and supermarkets. Some retailers sell their potatoes in polythene bags (usually 1–2 kg). Ware potatoes are not packaged in paper bags at present.

Kenya has an expanding food processing industry, driven by its growing urban population, changing population structure, new eating habits and increased tourism. The industry requires potato varieties with better processing qualities (for example, 'Kerr's Pink' and 'Dutch Robjin' are suitable for crisps, 'Roslin Tana' and 'Nyayo' for chips) to replace the old traditional varieties that are susceptible to bacterial and viral diseases. At least one processor imports processing varieties from Egypt mainly for better traceability. Others are calling for imports of suitable varieties to meet their needs for better-quality raw material for processing.

Trends in producer prices

Potato supply at local level normally follows local rainfall patterns. Supply is highest during harvest and lowest during planting. Prices are determined by, and vary with, supply and demand, seasonality, the state of marketing channels and potato quality. Normally prices follow a seasonal pattern: high at the start of planting, then declining gradually as supplies increase to reach their lowest level at the main harvest time before starting to rise again as surpluses are sold off (Figure 4).

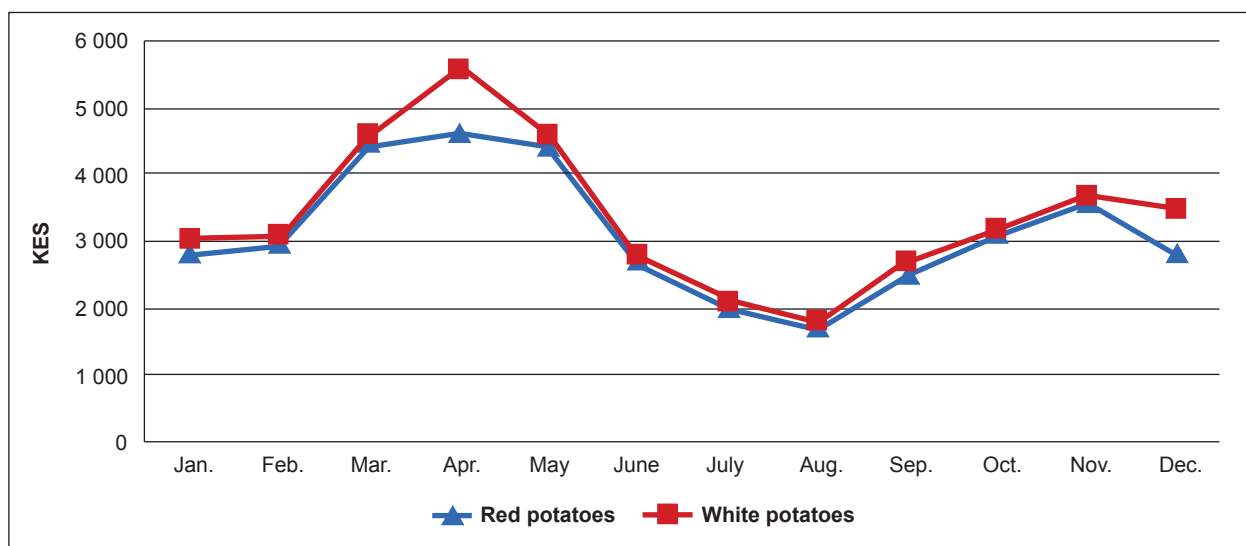
Farmgate prices are affected by supply and demand, as well as the distance to wholesale markets and the poor state of the rural feeder roads. Itinerant brokers base the prices they offer growers on the anticipated resale of those tubers through wholesalers to consumers in urban centres. Producers tend to accept the traders' stated terms of sale because they are not in a strong position to influence selling prices for a variety of reasons:

- meagre market surpluses
- geographic isolation
- limited access to information
- need for cash
- little adherence to farmers' associations (that could enhance their weak negotiating position)

There are seasonal and spatial variations in the prices of red and white potato varieties (see Figures 4 and 5). For example, in 2011, the average monthly retail price of red-skinned potatoes in Nairobi was

FIGURE 4

Average monthly retail prices for red- and white-skinned potatoes in Nairobi, 2011



Source: MoA

USD 0.19–0.49/kg (KES 1 700–4 600/110 kg), while the price of white-skinned varieties was USD 0.19–0.59/kg (KES 1 800–5 600/110 kg)

Farmgate prices are sometimes 50 percent lower than prices in urban markets. In 2011, average wholesale prices for potatoes were highest in Taita Taveta market (averaging KES 3 110/110 kg) and lowest in Nyahururu market (KES 1 194/110 kg) – see Figure 5. However, potato prices reported by the MoA lend themselves to interpretation. While prices are reported per bag, the weight of the bags varies considerably and the actual price per kilogram is subject to wide variability. It is therefore not easy to determine with any degree of precision the difference between prices at farm level and those paid by consumers, the real price differentials between markets, or the effective cost of raw material for processing.

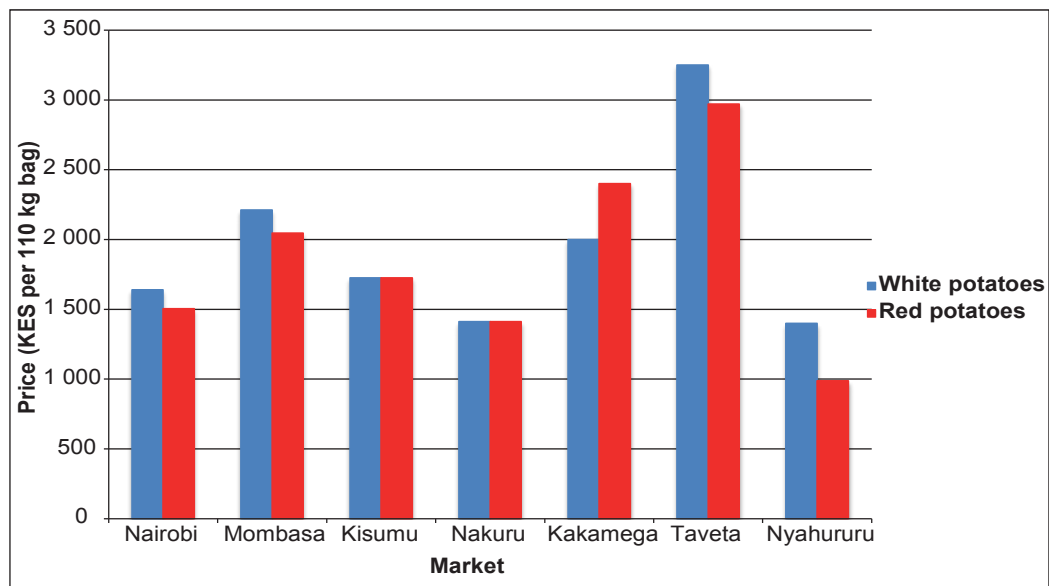
Potential for earning income and foreign exchange

At present, Kenya’s total potato imports and exports are negligible. Some informal, unrecorded trade

takes place with the United Republic of Tanzania and Uganda, with potatoes sent from production areas in Kenya to Mwanza in the United Republic of Tanzania. These are private-sector shipments and largely reflect seasonal production patterns, as well as trucking access to markets on both sides of the border. Overall, however, Kenya is a net importer of potatoes, and particularly of ware potatoes during specific months of the year. Annual volumes are extremely modest – no more than 5 300 tonnes in recent years according to FAOSTAT. In addition, a few dozen tonnes of processed potato products are currently being imported from South Africa and Egypt. These imports could easily be replaced by local supply, which would not only help farmers earn more income but also help the country save on foreign exchange.

There is also potential for increasing exports of fresh potatoes, processed products and seed potatoes of all categories beyond the very modest volumes now being shipped (Figure 10). However, Kenya’s potato production is characterized by seasonal gluts and waste, punctuated by periods of short supply. Efforts

FIGURE 5

Average wholesale prices for potatoes in selected markets in Kenya, 2010

Source: MoA

to increase exports of ware potatoes should focus, first, on stabilizing supplies and improving the quality of the tubers available within the country as part of a long-term process to increase competitiveness in potential export markets. While Kenya is exporting mini-tubers, current seed production is insufficient to satisfy domestic demand. A number of remedies, including use of rapid seed multiplication methods, are being undertaken. However, developing a potato export industry will take years of sustained effort to maintain quality control as the volumes produced and sold grow over time and extend to growers in different parts of the country. The breeding of newer varieties to meet export quality demands for seed, fresh ware and processed potatoes is a technical possibility. However, the scarce resources available, and the strong domestic demand for potatoes, make it advisable to focus development efforts on commercial opportunities in the domestic market in the years ahead, also because increased production of potatoes can help save foreign exchange by reducing food imports.

2.6 Research and extension

Most of Kenya's potato research is undertaken by the public sector at the Kenya Agricultural Research Institute in Tigoni, in collaboration with the International Potato Center (CIP), local universities, agrochemical companies, processors, farmers and KEPHIS. KARI-Tigoni, a national agricultural research centre, has the mandate to carry out research on all aspects of the potato and to make available recommended breeders' seed to seed growers for further multiplication. The programme carries out research in various areas:

- agronomy
- breeding
- crop protection
- food processing
- post-harvest technology
- pest and disease control
- seed research
- development of sustainable seed systems
- socio-economics
- technology transfer

Basic and applied research on major pests and diseases including bacterial wilt and viruses is carried out at the KARI National Agricultural Research Laboratories in Kabete (KARI-NARL Kabete) in collaboration with Tigoni, the agricultural faculties of various universities and CIP.

The Ministry of Agriculture is the main provider of extension services to the potato subsector, but delivery is inadequate owing to lack of staff and funding. There is no significant private sector or civil society involvement in extension service delivery for the potato in Kenya. Potato projects (e.g. those implemented by the Kenya National Federation of Agricultural Producers, KENFAP) also provide technical assistance to farmers within their projects. However, the linkages between research, extension and farmers remain weak in general. Public-private partnerships are found mainly in the area of seed production, but they too are modest.

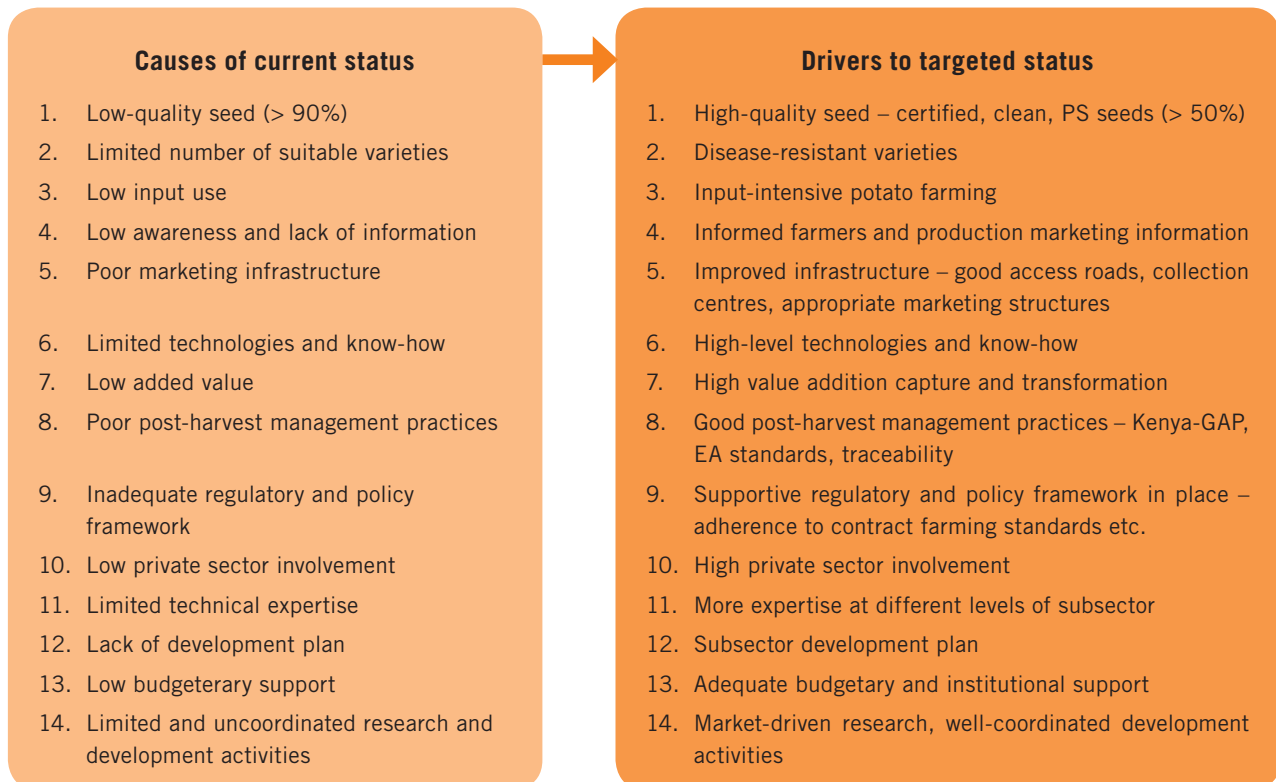
2.7 Value chains

In addition to production constraints, major weaknesses in the subsector beyond the farmgate have been identified in recent research on potato value chains (Kirumba *et al.*, 2004; Gildemacher *et al.*, 2009b). There have been efforts to strengthen the chains in the areas of seed production, marketing, policy development, farmer empowerment and the reorientation of research to the Agricultural Product Value Chain (APVC). Indeed, KARI and other development agents have adopted APVC approaches in research and development interventions.

However, greater endeavours are necessary to strengthen the chains so that the crop can fulfil its role and contribute to the delivery of the 10 percent annual economic growth rate envisaged by the country's long-term development blueprint, Kenya Vision 2030.

FIGURE 6

Causes of current status and drivers to targeted status of the potato subsector in Kenya



3. The role of public and private institutions

Key institutions: how they are positioned in the potato subsector and their strategies for continued growth and relevance



Mini-tubers growing in aeroponics

Research on basic and certified seed potatoes is carried out primarily by public institutions with funding from the Government and development partners. Private companies are involved primarily in processing and value-addition activities for potatoes. A few private companies are engaged in the production of mini-tubers. This chapter looks

at some of the key institutions operating in Kenya's potato subsector, how they are positioned and their strategies for fostering continued growth and relevance. The capacities of the institutions and their potential are evaluated using a SWOT (strengths, weaknesses, opportunities and threats) analysis.

3.1 Ministry of Agriculture

The MoA is mandated to create a favourable policy and legal framework for the development of the agricultural sector including the potato subsector. It coordinates:

- implementation of agricultural policies;
- extension and training;
- land and crop development; and
- agribusiness and marketing.

MoA SWOT analysis

Strengths

Strategic plan
 Strong implementation framework
 Skilled manpower and committed, dynamic, competent workforce
 Well-structured extension service
 Commitment (from Government) to enhance funding

Weaknesses

Budgetary constraints (due to multiple functions and broad mandate)
 Limited personnel
 Personnel transfers (following investment in capacity-building), resulting in inadequate and unevenly distributed workforce
 Poor information management (therefore achievements not well documented)

Opportunities

Potato an important food security crop (MoA committed to investing in the subsector to boost national food security)
 Spirit of public-private partnerships, resulting in enhanced collaboration within and outside sector ministries

Threats

Mergers, splits and transfers of functions
 Government restrictions on recruitment of technical personnel (constraining staffing and human resources management)
 MoA extension officers trained in technical potato issues transferred from potato-growing areas (replacement not guaranteed)
 Inadequate funding
 Staffing shortages with MoA officers very thin on the ground (particularly in view of the creation of new counties)

3.2 Kenya Agricultural Research Institute

The Kenya Agricultural Research Institute (KARI) is a public institute with the national mandate for agricultural research. KARI's mission is to contribute to productivity, commercialization and competitiveness by generating and promoting knowledge, information and technologies that meet clients' demands and respond to opportunities. KARI operates a National Potato Research Centre based in Tigoni-Limuru, that endeavours to meet the knowledge, information and technology demands of Kenya's potato producers, processors and consumers. The Centre generates basic potato seeds, new potato varieties, up-to-date production and pest control knowledge and post-harvest and processing technologies. Research on diseases, such as bacterial wilt, is conducted at KARI National Agricultural Research Laboratories at Kabete (KARI-NARL-Kabete), given the quarantine restrictions at KARI-Tigoni. KARI's strategic plan and implementation framework guide its research for 2009–2014. KARI's new constitution provides for the amalgamation of KARI with other non-agricultural research institutions. It is not clear how this will affect the management of potato research.

Human capital

The National Potato Research Centre researches breeding, agronomy, seed production, socio-economics, crop protection, technology transfer, and post-harvest technology and processing. Most of its programmes are understaffed: pathology currently has no working scientist; one scientist on PhD training works on flowers, and the other is on leave of absence; the post-harvest programme lost its only scientist when he became an administrator. Post-harvest research is currently conducted in collaboration with the University of Nairobi, while virology and storage engineering are without personnel or ongoing research. The socio-economics programme, which should investigate the demands, opportunities and requirements of producers and the market, and provide information and direction to the other programmes, lacks the resources and the interactive forum to do so effectively. Scientists tend to run independent programmes guided by their individual interests, project funding and programme history.

Physical infrastructure

KARI-Tigoni has facilities for research experiments and basic seed multiplication, including an

aeroponics unit, a tissue culture laboratory, land, screenhouses, glasshouses and a cold store with the capacity for 40 tonnes of basic seed and 10 tonnes of mini-tubers. The station currently has 3.24 ha of land available for seed multiplication per season, having lost more than 70 ha in the 1980s. The Centre has a total seasonal basic seed production capacity of 36 ha divided among three subcentres located in Meru (Marimba, 16.2 ha), Nyandarua (Njabini, 4 ha) and Nakuru (Marindas, 16.2 ha). The three subcentres are each meant to be the source of basic seed for a corresponding wider region in order that seed multipliers and farmers in the main potato-growing areas all have fairly easy access to seed potatoes for further multiplication to produce certified seeds.

Production

The average area under basic seed production per season is 6.5 ha in Tigoni, 4.9 ha in Njabini, 1.6 ha (of clean seed) in Marimba, and 5.7 ha in Marindas. None of the three subcentres has irrigation facilities, and all have very basic storage structures. Seed cannot be produced off-season and then stored until the onset of the rains, when seed multipliers need it, nor stored for at least one season so that they are already sprouted when made available to seed multipliers. Most of the infrastructure at Tigoni's subcentres was built in the 1970s and 1980s, and only minimal improvements have been carried out since then. The exception is Tigoni itself – its seed stores were refurbished and the tissue culture laboratory expanded in 2011 with funding from the Government of Kenya through the MOA. The irrigation system was upgraded in the 1990s to run off the electricity grid rather than a diesel generator.

Partnerships and collaborations

The Centre collaborates with CIP on germplasm acquisition, seed production technologies and other technical backstopping in crop protection and agronomy. It works in collaboration with various universities (e.g. University of Nairobi, Mount Kenya University, Jomo Kenyatta University, Kenyatta University, Masinde Muliro and Methodist University), and students carry out the research component of their studies at the Centre through collaborative programmes. The Centre also works in partnership with input providers (mainly chemical companies) for the testing of new pesticide products, with NGOs in development work and with the MoA in the training and equipping of extensionists, farmers and small-scale processors.

KARI SWOT analysis

Strengths

Programmes vital to the growth of the potato subsector

Core strengths to exploit – can drive development of the subsector and ensure increased productivity in a constantly changing environment

Three strategically located subcentres – a potential source of basic and certified seeds for all the seed multipliers in each subcentre's surrounding regions

Some infrastructure for carrying out its mandate (land, irrigation facilities at Tigoni, cold stores, diffused light store, screenhouses, aeroponics unit, laboratories for rapid multiplication and food technology)

Trained personnel – if motivated to work as a team, could make a substantial and sustained contribution to the productivity and effectiveness of the subsector

Weaknesses

Breeding programme not expanded to include newer techniques (e.g. marker-assisted breeding or genetic modification) to improve potato varieties that are popular with farmers/processors but which have some critical weaknesses

Programme totally reliant on CIP for germplasm – limiting its scope and ability to meet country's specific varietal needs

Lack of communication facilities (e.g. Internet) and strategic forums – scientists not regularly exposed to new thinking

Lack of irrigation facilities at subcentres – basic seed multiplication fully dependent on weather conditions, thus reducing capacity to effectively meet national basic seed demand

Inadequate recurrent and development funding – development limited (funds go to meet Centre's immediate operational needs, including research on agronomy, pathology and agricultural engineering)

Limited staff and lack of expertise in key areas (e.g. breeding) – reduced capacity to address key challenges facing the potato subsector

Quarantine for basic seed production difficult to maintain due to lack of minimum isolation distance required from neighbouring farms that produce ware potatoes

Basic seed sold to farmers for direct planting (instead of being multiplied to produce certified seeds, as originally planned) – costly and wasteful

Lack of partnerships with important stakeholders – Centre to some extent isolated from the rest of the potato subsector rather than a necessary and integral part of it

Opportunities

High demand for imported seed for various specialized uses and growing exports to countries in the region (e.g. Burundi and the Democratic Republic of the Congo) – great opportunity for seed production and the release of new varieties for specific niches

Increasing population – therefore increase in demand for potatoes and potato products, changes in consumption patterns and the expansion of potato production into non-traditional areas, with relevant research opportunities (optimal production practices for various areas and conditions, new products and optimal processing practices, and new varieties giving optimal yields under irrigation in various agro-ecological conditions)

Increasing use of ICT (Internet spreading rapidly in Kenya, with an estimated 14.3 million users and an estimated 36.3 percent of the population with Internet access), i.e. vast untapped clientele (that KARI could better serve by developing a more interactive and frequently updated Web site) plus potential of social media to help the centre expand its presence and interact more effectively with subsector stakeholders

Threats

Global warming and climate change – recommended production (agronomic/disease control) practices may need updating

Lack of irrigation facilities – fluctuation of basic seed yields

Seed importation and the risk of introducing hitherto unknown pests and diseases with potentially devastating effect (e.g. *Dickeya solanii*, more virulent strains of viruses and late blight mating type 2)

Evolution of methods of accessing and sharing information nationwide – if continue to not be embraced, risk of marginalization from broader efforts in innovation, development and dissemination, despite the fact that one of the Centre's core functions is information generation and sharing

3.3 Kenya Plant Health Inspectorate Services

The Kenya Plant Health Inspectorate Services (KEPHIS) is a key public institution with a national seed inspectorate mandate. The mission of KEPHIS is to provide an effective and efficient science-based regulatory service for quality assurance of seed and other inputs, thereby promoting sustainable economic growth and development. For potatoes, KEPHIS provides a range of services:

- regulation of new variety release (NPT [New Plant Type] and DSL);
- plant variety protection (granting plant breeders rights, and conducting Distinctness, Uniformity and Stability [DUS] tests);
- seed quality control (seed certification, field testing, seed sampling, laboratory seed testing, seed stockist licensing, registration of seed merchants);
- plant health protection (inspection of plant material exports, plant material interceptions in export destinations, inspection of imported materials, plant quarantine services); and
- quality assurance for agricultural inputs and produce (analysis and certification of agro-input formulations, agrochemical residue analysis).

KEPHIS management systems are aligned to current international management systems through ISO 9001:2008 certification. The seed testing and analytical chemistry laboratories at KEPHIS are internationally accredited for verifying or validating the technical competence of their laboratories to perform specific types of testing, measuring and calibration. The seed testing laboratory is accredited by the International Seed Testing Association (ISTA) and the analytical chemist laboratory by the South African National Accreditation System (SANAS).

Human capital

KEPHIS has adequately skilled personnel in all stations. However, the task of conducting seed inspection and certification all over the country is beyond its current capacity, often resulting in delays. Such delays can lead to large losses for seed producers. An accreditation bill awaiting parliamentary approval would allow KEPHIS to authorize private services to provide certification services for potatoes in non-critical areas, such as preliminary certification (e.g. of the suitability of land for certified seed production) and dehauling. Critical stages of certification would however remain with KEPHIS. The authorization bill is in line with international trends to allow approximately 5 percent privatization of the certification process.

Physical infrastructure

KEPHIS has a national office in Nairobi and a plant quarantine station in Muguga. Regional offices are located in Nakuru, Kitale, Mombasa, Kisumu and Embu. The regional offices have specific mandates that ensure coverage of the entire country. Additionally, KEPHIS has laboratories that can test for potato diseases in Nairobi, Muguga and Nakuru. KEPHIS is also planning to open another laboratory at its headquarters in Nairobi to meet increased demand from various stakeholders.

Partnerships and collaborations

KEPHIS works in partnership with the Organisation for Economic Co-operation and Development (OECD) to continually update and develop internationally recognized standards, and with the International Union for the Protection of New Varieties of Plants (UPOV).

KEPHIS SWOT analysis

Strengths

Science-based regulatory services internationally recognized – activities have legal and constitutional backing within the country

Credibility and good standing in the East Africa region – offers guidance in the establishment of harmonized laws and standards to ensure protection of potato production

Ability (in partnership with other relevant bodies) to guide, protect and uphold regional potato subsector to globally acceptable standards, easing barriers to future trading with the rest of the world

Qualified personnel and state-of-the-art laboratories (by regional and continental standards) regularly upgraded and certified

Recognized regional centre of excellence for phytosanitary issues

Interactive Web site, providing information on KEPHIS core business functions – area-specific search service for registered merchants, region-specific search service for recommended seed varieties, online application for certification

Investments made in molecular testing equipment and in technical capacity to detect genetically modified crops and organisms

Weaknesses

Inability to enforce internal quarantine in the case of disease outbreak in a specific region of the country (regulations for internal quarantine are in place, but contradicted by by-laws)

High costs due to rising inflation (despite services provided at a minimal or break-even cost) – farmers would prefer the Government to subsidize costs so that more growers can make frequent and widespread use of KEPHIS services

ICT use good, but not optimal – service on recommended seed varieties for potatoes limited and only a few areas covered

Bureaucracy – slows down process of reviewing and amending regulations

Varying interest in seed laws and regulations among stakeholders

Opportunities

Excellent scope for the testing of new molecular technologies

Potential to spread influence as the region integrates – well respected in EAC countries, reference point for potato certification (training personnel from other countries), ensures replication of current potato standards in other EAC countries

Threats

Illegal importation of potatoes – KEPHIS subject to political pressure and lobbying to permit imports of potato seeds contrary to the provisions laid down in the law (threat somewhat minimized by presence of new constitution and a judiciary being established as an independent guardian of the law)

Increasing spread of bacterial wilt, hindering certified seed production in certain parts of the country (seed potatoes must have zero bacterial wilt levels)

Inability of institutional and organizational capacity to keep pace with demand

3.4 Agricultural Development Corporation

The Agricultural Development Corporation (ADC) is the public institution charged with multiplying basic seed potatoes into certified seeds for Kenyan farmers. Its mission is to promote sustainable agricultural development and reconstruction in Kenya by initiating, assisting and expanding agricultural enterprises through production and supply of quality seed, technological transfers and training in a sustainable and affordable manner. As part of this mission, ADC produces certified seed potatoes for sale to interested potato growers. ADC gets breeder's basic seed from Tigoni, which it then multiplies three times under field conditions into certified 4 (C4) seed before selling it to farmers.

Current situation

ADC currently has some 80 ha under certified seed potatoes, but this area is projected to increase to almost 300 ha. The corporation's long-term goal is to cultivate 1 200 ha of certified seed potatoes. ADC is in the process of building up its capacity for basic seed production by putting up glasshouses and aeroponics units.

Personnel

ADC has a manager and an assistant manager in each of the three farms used for certified seed production. All seed potato production activities are coordinated by a potato cold store manager in Molo. ADC has sufficient staff to carry out current

production activities and more can be hired as needed. ADC also produces small quantities of certified seed through contractual arrangements with outgrower seed multipliers. Limited financial and technical capacity prevents ADC from engaging more farmers in these activities.

Infrastructure

Land. ADC has sufficient tracts of land that could be used for seed potato production. These include Sirikwa (67 ha), Asante (300 ha) and Enchili (700 ha) farms. The corporation is in the process of acquiring another farm in Mau Narok – Skof, with over 500 ha – and it has a number of other farms that could be used for seed potato production should the need for more land arise. ADC had more than 7 700 ha for certified seed production in the 1990s.

Glasshouses and aeroponics. ADC has one glasshouse at Sirikiwa with a capacity of 2 500 pots and is in the process of building two more; it has one aeroponics unit with a capacity of 480 plants and another one planned by 2016. ADC also has a tissue culture laboratory used for the production of plantlets.

Partnerships and collaboration

ADC collaborates with KARI to obtain basic or breeder's seed for further multiplication. It has also collaborated with CIP and GIZ-PSDA in the construction of the aeroponics unit and training. The MoA is the parent ministry and assists ADC in basic seed and land acquisition as well as in occasional funding for the institution.

ADC SWOT analysis

Strengths

- Sufficient resources (land, aeroponics facilities, screenhouses etc.) for certified seed production, including cold storage facility with a capacity of 1 950 tonnes of seed potatoes
- Experience in seed potato production dating back to 1979
- Human resources with the technical capacity to handle seed production more effectively than local competitors
- Allocation of KES 18 million (USD 215 000) by Government to construct a tissue culture laboratory and rehabilitate its cold store
- Experienced network with distributors and agrovet dealers

Weaknesses

- No distribution system for certified seeds produced – farmers seeking seed potatoes must travel up to 200 km to Molo (majority of ADC's buyers come from Kericho, Bomet, Molo, Nakuru and Mau Narok, all of which are far from the Centre)
- Inadequate promotion and information dissemination of certified seeds, limiting farmers' knowledge of quantities and varieties available
- Limited resources for certified seed production – operational and overhead costs must be covered despite time lag between basic seed acquisition from KARI-Tigoni, further multiplication in ADC farms and sale of certified seeds
- Price of certified seeds from ADC – not in line with market trends and realities, but set periodically by board of directors whose primary objective is to cover production costs
- Mismatch between varieties farmers want and those ADC can supply – most commonly supplied varieties from the centre are 'Dutch Robjin', 'Asante' and 'Tigoni'

Opportunities

- Growing market for certified seeds – despite variety supply and demand mismatches, certified seeds produced at the centre are usually sold out, implying existing high demand to expand potato production using certified seed
- Potential for use of by-products from certified seed production, namely ware potatoes (tubers too large to be classified as seed but can be used to produce other products)

Threats

- Climate change combined with lack of irrigation to mitigate negative effects – one farm, Asante, has a water body but water may be contaminated by microbes as the catchment area includes farms producing potatoes
- Competition from upcoming firms dealing with seed potato production and distribution

3.5 Private seed multipliers

There are a small number of private sector seed multipliers. Two of the most successful are Kisima Farm in Meru County and Genetics Technologies International Limited (GTIL) in Nairobi County. Both companies have aeroponics units for potato mini-tuber production. Kisima Farm also multiplies its mini-tubers further in the field to produce certified seeds. GTIL does not do any field multiplication; rather it sells its seeds as mini-tubers.

Mini-tubers produced by both companies are certified by KEPHIS, although the Seed and Plant Varieties Act (Cap. 326) does not address mini-tuber certification with regard to aspects such as plant spacing, maturity details and tuber size. KEPHIS therefore uses existing guidelines for certified seed production to certify mini-tubers.

Both companies export their mini-tubers to neighbouring countries. KEPHIS certification provides reputable quality verification of the mini-tubers. Kisima Farm packs its certified seeds in 50-kg sisal bags and in smaller quantities (mainly 5 and 10 kg).

Human capital

Kisima and GTIL have the necessary technical expertise and human resources to effectively run the aeroponics units; Kisima Farm also has a qualified manager dealing in certified seed field multiplication.

Physical infrastructure

Kisima Farm has vast tracts of land with ample room for the rotation needed for certified seed production. Kisima Farm has 8 ha of land under certified seed every season and has sufficient land for expansion.

Partnerships and collaboration

Both Kisima Farm and GTIL have collaborated with CIP to obtain partial funding and support from USAID (United States Agency for International Development) for their aeroponics units in the 3G (3 generation) project. CIP provided technical knowledge and backstopping, while USAID provided funding. Kisima has also collaborated with other development partners and NGOs, such as GIZ-PSDA and FIPS (Farm Input Promotions), to create awareness and to distribute some of their certified seeds. When Kisima was first becoming established, it was in a partnership with KARI and used KARI's seed merchant certificate to produce certified seeds. Support for the field multiplication of KARI's latest variety releases (2010) of 'Kenya Mpya', 'Kenya Sherekea' and 'Purple Gold' was provided by Kisima Farm. GTIL's partners include CIP, as well as other regional partners; CIP's germplasm for the region is multiplied by GTIL. GTIL currently exports most of its mini-tubers, while Kisima exports some of its mini tubers.

Private seed multipliers SWOT analysis

Strengths

Resources and capacity to produce significant quantities of potato seed mini-tubers (Kisima Farm can also produce certified seeds)

Capacity to easily respond to changing seed market demands thanks to the flexibility of organizational structure

Weaknesses

Rain-dependence – seed to be sold for planting may be delayed or not well sprouted as fresh from the field

Lacks of distribution system – farmers must travel to obtain planting materials

Need to establish system to advertise seed availability (however, Kisima's partners do advertise on its behalf whenever possible or convenient)

Opportunities

Regional EAC integration – providing expansive market to which seed multipliers can export both mini-tubers and certified seeds

Huge gap to be filled (especially in areas where the potato is a commercial crop and farmers seek highest return possible) – certified seed currently available to less than 1 percent of all potato farmers

Expansion of potato production in non-traditional areas, increasing demand for high-quality seeds

Key role to play in subsector – if manage to address challenges

Threats

Inconsistency of crops inspection reports and delayed inspection process by KEPHIS – may lead to unexpected losses

Decreased competitiveness of seed acquired from public sector – in terms of both quality and quantity

3.6 National Potato Council of Kenya

The National Potato Council of Kenya (NPCK) is a member-based, non-profit organization comprising diverse institutions from the public and private sector. Its mission is to coordinate and regulate potato subsector stakeholders towards development of greater potato industry profitability and the improvement of livelihoods. The organization was established to address the many and complex challenges and bottlenecks constraining development of the potato subsector. The Council, which was launched on 25 November 2010, is responsible for:

- enabling better vertical and horizontal interrelationships among stakeholders;
- helping develop the subsector into a self-regulating and competitive industry;
- facilitating policy formulation and review; and
- encouraging better enforcement of existing regulations and standards.

The NPCK is structured to promote greater synergies among a broad membership including researchers (KARI, CIP), academia (universities), extensionists (MoA), farmers (KENAPOFA, KENFAP), seed producers (ADC, GTIL, Kisima Farm), traders, processors, exporters, regulatory agents (KEPHIS) and development partners (GIZ-PSDA, USAID).

Human capital

The NPCK has an established secretariat under the leadership of a CEO (Chief Executive Officer) assisted by sectorial managers, officers and support staff. Being relatively new, the Council has not

yet secured a project but it supports its staff with activity-based consultancies. The NPCK's human capital is potentially unlimited and is in a position to mobilize and bring together diverse professionals as short-term experts from member institutions, thereby ensuring efficient delivery of services.

Physical infrastructure

The newly established NPCK national office is situated on the KARI-NARL premises. The Council is in the process of mobilizing resources to strengthen its national offices and also its presence in the main potato-producing counties countrywide.

Partnerships and collaboration

The NPCK collaborates with member organizations, in particular pooling human resources and technical information. It has formed partnerships with various international organizations and development partners including CIP, GIZ, FAO and the WB (World Bank)-funded Kenya Agricultural Productivity and Agribusiness Project (KAPAP) to promote enhanced potato productivity in Kenya. Other partnerships have been made with: the Ministry of Agriculture (through KARI, SHOMaP [Smallholder Horticulture Marketing Programme], EAAPP [Eastern Africa Agricultural Productivity Project]); the Ministry of Science and Technology (through the National Council of Science and Technology); the Ministry of Education (through the universities); and the Ministry of Local Government (for marketing-related issues). The NPCK is also collaborating with FPEAK (Fresh Produce Exporters Association of Kenya) to develop Kenya-GAP standards for potatoes.

National Potato Council of Kenya SWOT analysis

Strengths

Needs-based organization formed by stakeholders responding to problems faced in the subsector

Strong linkages with multiple and diverse stakeholders whose expertise can be readily tapped to further develop the subsector

Forum for stakeholders to meet, interact and engage

Legal entity in good standing with donors, development partners, stakeholders and the Government, with membership incorporating all stakeholders of the value chains

Weaknesses

Lack of adequate funding for all the activities needed to realize objectives

Lack of awareness among stakeholders of existence and role

Lack of confidence among subsector actors and development partners – a new entity and structure, multistakeholder composition and PPP (public-private partnership) approach unfamiliar

Sustainability yet to be achieved – government legislation required to allow cess collection at markets (or similar initiatives allowing levy collection from subsector participants, as with potato councils in countries such as South Africa and the United Kingdom)

Opportunities

Immense potential for the NPCK to systematically address the myriad problems limiting the potato subsector, exploiting partnerships and funding opportunities with a wide range of potential partners and donors (funding partners) as scope of work is immensely wide

Great growth potential to be capitalized on by developing and regulating the subsector

Threats

Decentralization of government decision-making – unclear how counties will deal with national commodity organizations like the NPCK

Competition for financial resources with local authorities – levy collection at county level a potential problem

3.7 Kenya National Potato Farmers Association

The Kenya National Potato Farmers Association (KENAPOFA) is a private sector initiative whose mission is to:

- ensure accessibility of high-quality services and products to local and international markets; and
- promote cohesive interaction and free flow of information amongst farmers.

KENAPOFA is a farmers' alliance that was formed in 2003, was registered in March 2006 and held its first AGM (annual general meeting) and elections on 8 December 2006. The first national leadership was elected from the nine major potato-growing counties (Kiambu, Meru, Nyeri, Nakuru, Nyandarua, Bomet, Narok, Uasin Gishu and Transmara).

Human capital

KENAPOFA has nine district representatives. Each district has a KENAPOFA committee with members drawn from each location in the district. In its original form, it was very active between 2006 and 2008, meeting on a regular basis as it had funding from

the Kenya Agricultural Productivity Project (KAPP) for sensitization and mobilization. Since 2008, the Association has had a few funded projects¹ but otherwise it has limited finances to run its affairs. The nine KENAPOFA officials currently volunteer their services while implementing some of the projects that the association has received funding for.

Physical infrastructure

KENAPOFA offices are based at KARI-NARL, with a coordinator under the supervision of the NPCK. MoA offices in various districts are used to perform essential business and carry out publicity drives.

Partnerships and collaboration

KENAPOFA is a member of the Kenya National Federation of Agricultural Producers (KENFAP), an umbrella body for farmers' associations. Development partners, including GIZ, BAF (Business Advocacy Fund), USAID and KAPAP, have facilitated various KENAPOFA activities. FM radio stations have featured KENAPOFA officials on programmes, creating awareness of KENAPOFA among audiences. The association plans to work closely with the NPCK and establish joint offices at county level.

Kenya National Potato Farmers Association SWOT analysis

Strengths

Availability of membership base – with elected and credible officials in each of the major potato-growing areas, KENAPOFA could articulate and lobby on behalf of farmers

Weaknesses

Credibility undermined by failed popularization campaigns – sensitization and recruitment drives focused on the much-abhorred extended bag, and as an incentive to get farmers to join the association and pay membership fees, recruiters made unkept promise to get the bag abolished, therefore farmers now reluctant to keep up annual membership payments

Lack of active officials and physical offices at county level – difficult to coordinate KENAPOFA activities and sustain member recruitment

Absence of strong and qualified secretariat and leadership – fundraising and expansion are a challenge

Opportunities

Growing population – potential for expansion of potato production and of membership base

Sole voice of potato farmers – potentially significant impact on the livelihoods of potato farmers

NPCK active and able – can popularize and strengthen KENAPOFA as it helps grow and organize its membership

Need for private-public partnerships well articulated by national policies and strategies

Threats

Lack of credibility – appears not to have accomplished what potato producers believed it was created for

Political interference – can harm KENAPOFA if officials are elected with political inclinations at local and national level

¹ For example: a study on why legal notice is not implemented by Business Advocacy Fund (BAF) sensitization and a consensus workshop with local government to actualize Legal Notice 113 by BAF; and construction of a model collection centre in Lari by Round Table Africa (RTA) that was rerouted to clean seed production after locals disagreed on the location of the centre.

3.8 Kenya National Federation of Agricultural Producers

KENFAP is the umbrella body of farmers in the country, bringing together 60 farmers' associations (initially branches) at district (turned county) level, 36 national commodity-based associations, 16 cooperatives and close to 8 000 farmers' groups. KENFAP envisions an empowered Kenyan farmer with a strong voice. Its mission is to empower farmers to make informed choices for improved, sustainable livelihoods and comprises seven objectives:

1. Organization of farmers' groups in federations
2. Effective intervention in farming matters to yield timely solutions
3. Encouragement of collaboration between actors for mutual gain
4. Policy review and participation in formulation to shape the farming environment

5. Creation of consultative platforms and promotion of consultation with other actors to improve agricultural practices
6. Intervention in issues relative to agricultural products and the value chain in order to benefit farmers by effectively representing their interests
7. Strengthening of farmer institutions through various forms of capacity enhancement

KENFAP has chaired the potato task force since its inception and is instrumental in the realization of potato policies and strategic efforts; it was a key player in steering subsector stakeholders to form the NPCK. The Federation currently implements a potato project under the Kenya Horticulture Competitiveness Project (KHCP), a USAID-funded initiative. The project aims to: redress the seed shortage; promote greater productivity through better access to seed; and use the right mix of technologies.

Kenya National Federation of Agricultural Producers SWOT analysis

Strengths

Elaborate, nationwide structure

Farmer initiation and management

Strong commodity focus – each enterprise is handled by a specific, commodity-based association

Excellent capacity for institutional development and organizational strengthening (ID/OS) – important for supporting strong potato institutions

Technically sound, countrywide personnel

Excellent professional capacity – especially in lobbying and advocacy

Weaknesses

Little involvement in real issues – focus is the same and therefore relegated to specialized, commodity-specific organizations such as KENAPOFA

Limited financial power – difficult to effectively influence key actors through targeted and progressive campaigns

Opportunities

Support from political and legislative environment

Willingness among farmers to be organized into strong potato producers and marketing entities

Subsector stakeholders supportive and resourceful

Inbuilt flexibility of operable policy environment to moderate excesses

Responsiveness and objectivity of donor community within agriculture sector

Threats

Risk of being overwhelmed, becoming fragmented and subsequently abandoned by disillusioned members if high demand for action on different issues outstretches the Federation's capabilities to respond effectively to farmers' needs

3.9 Potato processing companies

This section examines two processing companies (Deepa Industries and Njoro Canning) that are privately owned, and one processing company (Midlands) which is a public company owned by farmer shareholders. The three companies process potatoes into different products: Deepa Industries makes mainly crisps and chevra; Njoro Canning makes mainly frozen chips; Midlands makes chilled chips. Deepa Industries and Njoro Canning have been processing potatoes for a number of years, while Midlands has only recently started testing their potato processing capacity. All three companies process other products besides potatoes.

Partnerships and collaboration

All three companies collaborate with various partners according to the competitive advantages offered by each. During establishment of the processing factory, Njoro Canning consulted KARI-Tigoni to select the best Kenyan varieties for making quality

frozen chips. In the five years until December 2012, Deepa Industries partnered CIP, KARI and the MoA under a Common Fund for Commodities (CFC) project to improve the capacity and willingness of farmers to produce quality potatoes for the factory and to help select new processing varieties. Midlands collaborates with farmers as it is a farmer-owned organization. The processing companies are also members of the NPCK and work closely with the Council to address challenges and identify opportunities.

In summary, the various institutions reviewed differ in many ways – some are prepared to serve a vibrant potato subsector, while others lag behind. Each institution has strengths to build upon and weaknesses to address. However, with strategic planning, realignment, capacity-building and resource mobilization, these institutions are in a position to contribute to building a robust and competitive industry, particularly if activities are well aligned and coordinated.

Potato processing companies SWOT analysis

Strengths

Processing capacity for respective products

Availability of human resources – companies benefit from well-trained Kenyan labour

Weaknesses

Enforcement of producer contracts problematic – when supply is low, farmers tend to renege on their contracts and sell to alternative markets with higher prices

High processing losses when poor-quality tubers produced:

- harvest of immature tubers widespread to take advantage of early season price peaks before supply increases and prices collapse (but tubers rot easily and have a high sugar content)
- use of extended bags (tubers become easily damaged when the heavy sacks are dragged and dropped and the conversion rates from raw material to finished product are therefore poor)

Fluctuating supply of potatoes during the year combined with limited on- and off-farm storage of ware potatoes – periods of glut followed by periods of acute shortages result in unstable year-round supplies

Lack of price incentives for quality potatoes in the market – potatoes traded on a per bag basis with no price differential for mature, large tubers, and farmers, therefore, not motivated to grade potatoes or to pack well-matured potatoes

Availability of limited number of varieties suitable for processing into different potato products (farmers not always keen to grow them):

- Deepa Industries uses 'Dutch Robjin' (popular with farmers in Bomet County, despite susceptibility to late blight)
- Njoro Canning uses 'Tigoni' (procurement problems in last 2–3 years as farmers opt for more marketable 'Zangi', which sells at a higher price)
- Midlands has just started using 'Zangi' (not yet an officially released variety and certified seed therefore not available – processors using 'Zangi' face high post-harvest losses due in particular to bacterial wilt which leaves a distinct mark on the tubers)

Opportunities

Population growth and increased demand for potato products – prospect of greater sales if products satisfy changing tastes and preferences

EAC market – creates opportunities for increased exports of Kenyan processed potato products to neighbouring countries:

- increased acceptability of products when companies implement EAC standards
- wide acceptance of the Kenya Bureau of Standards (KEBS) diamond mark of quality

Substitution by local processors of imported potato snacks widely available on the market, especially in big supermarkets and tourist hotels

Threats

Perception of potato products as unhealthy – increasingly health conscious Kenyan population may reduce consumption of potato products

Lack of access to credit facilities among potato growers and inability to take advantage of crop insurance – limiting ability to produce potatoes optimally, discouraging farmers from producing potatoes, resulting in negative impact on potato processors

4. Subsector interventions: policies, research and development

Recent activities related to capacity-building, promotion of potato technologies, value addition and market access for seed, ware and potato products



Well-sprouted potatoes in a diffused light store

In recent decades, numerous development programmes and projects have focused on sub-Saharan Africa's potato subsector, and a number of potato technologies and best practices have been developed for transfer and use. While these innovations have the potential to improve productivity, progress has been held back by low adoption rates among farmers.

More recent initiatives aimed at revitalizing the potato subsector in Kenya have been funded by the Government, development partners and the private sector. The MoA has recently helped to develop potato policies to provide an enabling environment for further growth of the industry.

As a result of these concerted efforts, the subsector has witnessed over the last five years (2007–2011) a remarkable improvement in farmers' knowledge and skills, seed potato production, adoption of seed and ware potato technologies and best practices, as well as an increase in private sector participation, particularly over the last five years (2007–2011).

Despite these positive developments, performance of Kenya's potato subsector is still far below its potential due to several persistent constraints, including:

- inadequate supply of quality seed;
- lack of effective policies and limited policy implementation;
- poor agronomic practices;
- high incidence of diseases and pests;
- limited number and diversity of varieties;
- high rates of post-harvest losses; and
- unstructured marketing channels.

4.1 Seed multiplication technologies

Tissue culture facilities and screenhouses

The availability of tissue culture (TC) facilities and screenhouses is important in the propagation of *in vitro* potato plantlets. For many years, Kenya relied entirely on the TC facility at KARI-Tigoni. This limited the annual output of *in vitro* plantlets. Between 2008 and 2011, the number and the capacity of TC facilities increased (Table 4) with the construction of a new TC facility at the ADC-Molo complex in 2009 and the upgrading of the second TC unit at KARI-Tigoni in 2010. In 2008, under a public-private partnership (PPP) supported by the joint Kenya-Germany Promotion of Private Sector Development in Agriculture (GIZ/PSDA) programme and USAID, a private firm, GTIL, began producing *in vitro* plantlets and mini-tubers. The PSDA programme is a bilateral arrangement jointly implemented by GIZ on behalf of the Federal Ministry for Economic Cooperation and Development (BMZ) of the Government of Germany and the Government of Kenya.

TABLE 4

Tissue culture facilities and their capacity in Kenya

Institution	Category	Capacity (no. <i>in vitro</i> plantlets)	Status/Remarks
KARI-Tigoni	Public	16 000 (unit 1)	The second unit was upgraded in 2010
		50 000 (unit 2)	
KEPHIS-PQS	Public	35 000	Good
ADC-Molo	Public	60 000	New, completed in 2009
GTIL	Private	> 200 000	Good, constructed in 1995 but started seed potato production in 2008

Rapid seed multiplication technologies

Until recently, the only source of mini-tubers in Kenya was a conventional soil-based, production system at KARI-Tigoni, with a capacity of fewer than 6 000 plantlets. Then in 2008, with the financial and technical support of the PSDA programme, USAID, CFC, CIP and the private sector in collaboration with KARI and the MoA, the aeroponics technology for mini-tuber production was introduced. Over a period of three years, a total of ten aeroponics units and an improved conventional system were constructed at KEPHIS-Muguga, with a capacity of approximately 26 000 plantlets. Of the ten units, seven are owned by private firms while the other three are owned by public institutions.

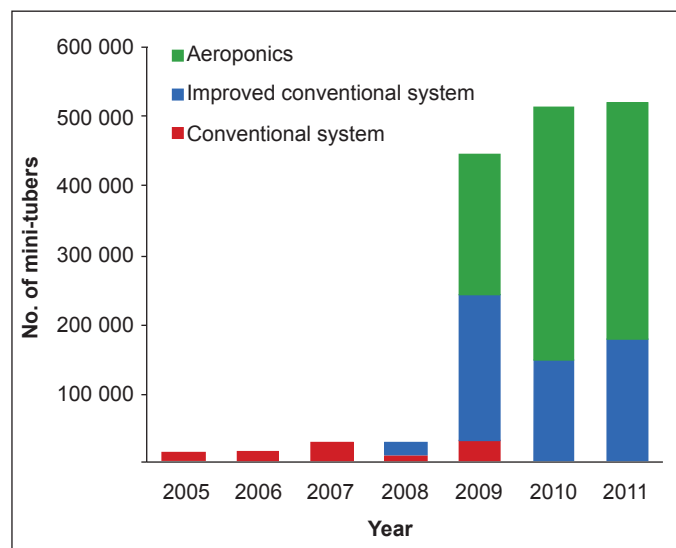
The introduction of aeroponics has increased Kenya's annual mini-tuber production more than tenfold: from around 35 000 to as many as 500 000 (Figure 7). Aeroponics has allowed large-scale production of mini-tubers with multiplication rates of 20–60 mini-tubers per plant – compared with fewer than 10 mini-tubers per plant obtained using the soil-based, conventional production system. Many varieties have been tested in the aeroponics systems, and further research is being undertaken by KARI and CIP to determine the performance of other important potato varieties grown in Kenya.

By introducing newly-released varieties into the aeroponics system, their diffusion to farmers has been considerably accelerated. For example, the variety 'Kenya Mpya' was released in May 2010 and certified seed was available by March 2011. Making quality seed of improved varieties available in such a short space of time is one of the major benefits of using modern technologies and ensures that farmers reap the full benefits of research innovations.

Aeroponics: growing potatoes in the air

Aeroponics is the process of growing plants in an air/mist environment without the use of soil or aggregate media. The roots of the plants are developed in a closed, dark container, empty except for air. Nutrients are provided periodically to the roots in the form of aerosol through nebulizers. Aeroponics boxes are made of simple materials such as wood, aluminum, Styrofoam and PVC pipes. Aeroponics results in high multiplication rates of about 50:1 compared with less than 10:1 under the conventional soil-based system and has low water and energy usage (Otazu, 2010).

FIGURE 7
Mini-tuber production trends using different multiplication methods in Kenya, 2005–2011



Source: CIP reports

4.2 Seed storage technology

Diffused Light Storage

Poor storage practices have negative effects:

- rapid seed deterioration due to unfavourable ambient conditions
- increased losses from pest attacks
- poor-quality seed (with few and weak sprouts)

The result is poor performance of the potato crop in the field. Diffused Light Storage (DLS) offers good potato-sprouting conditions by enhancing diffused light penetration and air circulation. The combination results in longer seed potato shelf-life. To improve the quality of seed potatoes planted by farmers, KARI-Tigoni and the MoA, with support from USAID in partnership with CIP, conducted extensive campaigns from 2008 to 2011 aimed at enhancing growers' awareness of the benefits of using DLS.

Prior to 2008, there were fewer than five DLS facilities with a total capacity of 20 tonnes. Since then, 65 stores with a total capacity of 200 tonnes have been either constructed or upgraded, including: large stores at ADC-Molo, KARI-Tigoni and its subcentres with a capacity of 10–20 tonnes; demonstration models located at Agricultural Training Centres (ATCs); and farmer-owned stores with a capacity of 2–8 tonnes. Aphid-proof nets have been used in DLS to protect seed and reduce the risks of virus infections, such as potato virus Y (PVY) and potato leaf roll virus (PLRV).

Currently, a collaborative project of NPCK, KARI, CIP, the MoA and Mount Kenya University, funded by the National Council for Science and Technology (NCST) and implemented in Nyandarua County, is evaluating the cost effectiveness of various kinds of DLS as well as promoting DLS technology.

Cold storage facilities

Cold storage at 3–4 °C is an expensive, but efficient way to store seed potatoes. It is important in Kenya where potato production is mainly rainfed and seed must be stored for 3–4 months before the next planting season. The country's largest cold storage facility, located at the ADC-Molo complex, was built in 1985 with the support of the Netherlands Government. The facility, which can hold up to 2 000 tonnes of seed, was rehabilitated in 2009 by the MoA. KARI-Tigoni also has a cold storage facility with a capacity of 40 tonnes.

Land for seed potato multiplication

A shortage of land for both research and seed multiplication has made it difficult to practise the mandatory minimum three-year fallow/crop rotation period. As a result, the amount of breeder and basic seed produced is inadequate. For example, breeders are required to produce 20 tonnes of pre-basic seed potatoes before the National Performance Trials Release Committee gives approval for release. Owing to the shortage of available land, this condition is usually not met. Shortage of land also severely hampers the evaluation of new progenies during breeding, which constrains the development of new varieties.

Currently, KARI-Tigoni has only 27 ha of land, and only 61 ha remain for ADC use in Sirikwa. Although the Government has recently purchased some 700 ha of land for potato development, the area is still less than the 1 200 ha required for effective seed potato production.

The MoA's ATCs have some land that could be strategically used to produce potato seed at county level, for example, in Mount Elgon, Keiyo/Marakwet, Nyandarua, Kiambu, Taita Taveta and Nyeri. The land shortage constraint could also be circumvented by promoting mutually beneficial partnerships between researchers and farmers or the private sector. Such partnerships could take the form of outgrower schemes or contract farming.

Capacity-building for farmers in seed potato production

Between 2004 and 2011, some 300 selected farmers and farm managers of government-owned ATCs, drawn from all of Kenya's major potato-producing areas, were trained in seed potato production. They participated in intensive workshops conducted by potato specialists from KARI, KEPHIS and CIP, in conjunction with the MoA through District Agricultural Offices (DAOs), and with financial support from the PSDA programme, USAID, CFC and others. The training included theory and practical sessions, which were followed by regular field visits, and advice was available at the various stages of the crop's vegetative cycle.

The seed multipliers were carefully selected by the DAOs, using a variety of criteria:

- size of land owned – to ensure proper crop rotation

- ability to purchase starter seed and other inputs
- central location of the production area
- level of literacy and willingness to follow recommended production guidelines

The seed potato training curricula covered a range of topics:

- seed quality maintenance
- management of major diseases
- seed storage
- sorting and grading
- the certification process
- negative selection
- the need for replenishing starter seed

The training guidelines emphasize the use of “negative selection” – the improvement of seed quality by identifying, uprooting and destroying diseased and stunted potato plants from the seed plots. Upon completion of training, seed potato multipliers were expected to procure starter seed from reputable basic seed producers and multiply it in their fields at least once before selling it to ware potato producers. KEPHIS, the seed regulatory body, conducts regular visual inspection of seed potato fields during the course of plant growth for registered seed growers. At harvest, they collect tuber samples to be tested for bacterial wilt (BW). Fields that do not meet the requisite quality standards are disqualified and the harvested tubers sold as ware potatoes.

Trained extension staff regularly conduct visual inspections of seed potato fields to ascertain the health of the crop. They also give advice to growers on producing clean seed (uncertified, high-quality seed equivalent to quality declared seed [QDS]). Currently, Kenya has more than 70 trained seed multipliers in the country, including 20 individual farmers and ATCs who are producing certified seed in addition to the 50 producing clean seed. The decentralization of seed production has led to improved accessibility of farmers to seed.

Public-private partnership initiatives

With support from GIZ, the MoA introduced public-private partnership (PPP) in 2004, when the GIZ-PSDA project was drawn up. However, private sector involvement in seed potato production became more prominent in 2008 when several private firms, with financial support from USAID and GIZ, invested in rapid seed multiplication technology (aeroponics) and large-scale field multiplication. These enterprises also received technical and field support from CIP, KARI and the MoA. Private sector

firms that continue to play an important role in seed production and distribution include GTIL, Kisima and Milwar farms, as well as Stephen Chege's farm, Kagia Farm, Suera Farm and Africalla. The presence of the private sector has not only increased the production of quality seed but has introduced marked improvements in efficiency, mechanization and production and accessibility of seed potatoes. Overall, the private sector accounted for more than 80 percent of the mini-tubers and basic seed produced in 2010 and 2011.

For example, GTIL with a large TC laboratory and three aeroponics facilities, embarked on large-scale production of *in vitro* plantlets and mini-tubers in 2008. By the end of 2011, it had produced and sold more than 20 000 *in vitro* plantlets and over 400 000 mini-tubers of several varieties and breeding lines in high demand. The mini-tubers were sold locally to large producers of basic seed, particularly Kisima and Milwar farms. The company also exported small quantities of mini-tubers to Ethiopia, Malawi, Mali, south Sudan and the United Republic of Tanzania. Similarly, Kisima Farm operates two aeroponics units which, between 2009 and 2011, produced and multiplied more than 600 000 mini-tubers of the popular ‘Tigoni’, ‘Asante’ and ‘Kenya Mpya’ varieties. The farm produced over 700 tonnes of G3 seed (generation three seed, equivalent to basic seed). Between 2009 and 2012, the farm planted about 20 ha of seed potatoes a year and invested in modern machinery and equipment.

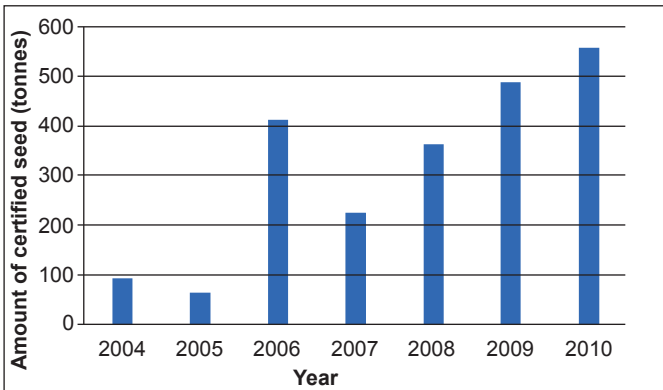
These initiatives have contributed to the increase in basic seed and certified seed production in Kenya. For example, Kisima Farm and KARI each had about 8 ha under basic seed during the 2010 short rains, while ADC had over 80 ha under certified seed in 2011. That was a major improvement over previous years when the total area under seed barely exceeded 8 ha. In 2010, production of certified seed increased to over 550 tonnes (up from about 200 tonnes in 2007 – Figure 8 overleaf).

Legislative, institutional and regulatory framework

To stimulate growth in the seed subsector for all crops, the Kenyan Government has formulated laws, policies and strategies aimed at creating an enabling environment for effective participation of both the public and private sector. The seed potato subsector is governed by a number of commodity-specific laws, standards and regulations, in addition to several acts:

FIGURE 8

Production of certified seed potatoes in Kenya, 2004–2010



Source: ADC reports

- Plant Protection Act (Cap. 324)
- Noxious Weeds Act (Cap. 325)
- Seed and Varieties Act (Cap. 326)
- Pest Control Product Act (Cap. 346)
- State Corporation Act (Cap. 446)

Seed potatoes are also governed by other laws, regulations and standards formulated during the last 10 years:

- Legal Notice No. 44 (2005), stipulating the standards and packaging of seeds
- Seed Potato Strategy (2005)
- Seed Policy (2011)

Kenya is a member of the International Seed Testing Association (ISTA) and International Union for the Protection of New Varieties of Plants (UPOV). At regional level, Kenya belongs to the African Seed Trade Association (AFSTA) and is one of the ten countries forming the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). Over the last five years, ASARECA has supported the harmonization of seed policies and regulations. The seed potato standards of the East African Community (EAC) were finalized in 2011, together with standards for ware and potato products. The “gazettement” – formal, legal publishing and dissemination – of EAC standards (EAS) is expected to enhance cross-border trade in seed potatoes.

Access to inputs, financing, credit and insurance

The high cost of farm inputs (particularly seed, fertilizers and agrochemicals), lack of access to affordable credit and unpredictable weather patterns

have all contributed to low and declining potato productivity. To mitigate the effects of these factors, the *Kilimo Biashara* (“agriculture as business”) initiative was launched in May 2008 – a partnership between the Government (MoA), Alliance for a Green Revolution in Africa (AGRA), Equity Bank and the International Fund for Agricultural Development (IFAD). Each partner contributed USD 2.5 million (KES 210 million) towards the cost of the project. The initiative aims to provide low-interest loans to small farmers to enable them to purchase necessary farm inputs, given that the majority of small farmers producing potatoes use lower rates of fertilizer (about 25 percent of the recommended rates) and their own recycled seed.

Farmers have welcomed the *Kilimo Biashara* initiative, and to date over 40 000 small farmers, including seed potato multipliers, have benefited from it. In the wake of *Kilimo Biashara*, other financial institutions, including the Kenya Commercial Bank (KCB) and Cooperative Bank, have opened their doors to small farmers who wish to apply for credit. Given the high demand for credit, microfinance institutions and the private sector have also started providing loans to small farmers.

In June 2005, *Njaa Marufuku Kenya* (“eradication of hunger in Kenya”, NMK) was launched by agriculture sector ministries with support from FAO and the MDG (Millennium Development Goals) Center, and the MoA was central to its implementation. The NMK programme aims to provide grants to trained seed groups. In just six years (2005–2011), the programme dispersed USD 5.6 million (KES 468.6 million) to 3 772 community groups, including seed potato groups comprising about 80 000 smallholders. To ensure sustainability, the programme has trained over 800 community group facilitators usually assigned to one or more of the groups of target beneficiaries to build their technical capacity.

The Government has also provided affordable inputs, in particular seed and fertilizers, using the voucher system facilitated by the DAOs under the National Accelerated Agricultural Inputs Access Programme (NAAIAP). Started in 2007 and administered through the MoA, NAAIAP aims to promote food security, agricultural input use, input market development and agricultural productivity, with a special focus on maize (the country staple) in selected districts. However, due to high demand, the benefits have spilled over to other crops and

other districts. Consequently, it has benefited potato farmers in districts where the potato is the main crop, reducing the cost of production.

In the face of climatic variability, the need for adaptation strategies cannot be underrated. The introduction of an agricultural weather-indexed insurance, *Kilimo Salama* (“safe agriculture”) in 2008 is therefore seen as a step in the right direction. The objective of this initiative – the first of its kind in Kenya, fronted by the Syngenta Foundation for Sustainable Agriculture in partnership with UAP Insurance and Safaricom – provides smallholders with simple, affordable and relevant insurance policies. They are thus protected from significant financial losses resulting from drought or excessive rainfall leading to crop failure. Although the initiative has yet to benefit seed potato multipliers, plans are underway to provide insurance policies to these growers as the Foundation scales up the initiative. The programme uses automated weather data to determine the payout and mobile banking to conduct the transaction.

Kilimo Faida (“profitable agriculture”) is an agribusiness value chain financing programme run under the flagship of Orion East Africa Limited. The programme targets both micro- and large-scale farmers and seeks to remove hindrances in agricultural value practice by providing low-cost credit through which farmers can: access farm inputs (agrochemicals and seeds); buy farm equipment to boost production; and access Letters of Credit, Guarantees and quick cash on their invoices (factoring). The programme also offers Bid Bonds to its established clients, and customers can obtain interest-free credit on farm inputs during planting seasons. *Kilimo Faida*'s objective is to ensure that farmers maximize their farm potential through the provision of easily accessible and affordable credit facilities.

Regional integration and trade in seed potatoes

The Kenya Plant Health Inspectorate Services (KEPHIS), the designated national authority (DNA), is internationally recognized, and KEPHIS-certified seed and ware potatoes are regionally and globally accepted. Kenya, therefore, has the capacity to guarantee the quality of its potatoes and its potato products and to market them in the region. The gazettement of EAC standards since 2010 is expected to result in increased cross-border trade of seed potatoes, although the amount currently traded

is quite low. For example: only 13 tonnes of seed were exported to the Sudan in 2008; exported seed reached its peak in 2010, when 150 tonnes of seed were sent to Uganda and 100 tonnes to the United Republic of Tanzania (Figure 10).

4.3 Ware potatoes

Research, development and extension initiatives

Research in ware potato production has concentrated on the development of production technologies for small farmers. Issues addressed in agronomy include crop rotation, fertilizer use, plant populations, soil moisture utilization, field hygiene, tillage, tuber sizes, weed control, variety evaluation and other cultural factors influencing storability and processing. In crop protection, the focus is on efficacy trials of new fungicide products, evaluation of the impact of cultural practices on disease and insect management, evaluation of crop protection constraints facing small farmers, integrated pest and disease management and evaluation of post-harvest diseases and insects associated with on-farm storage. Post-harvest and food processing research focuses on on-farm storage, evaluation of processing potential of stored potatoes and evaluation of the culinary qualities of advanced potato genotypes.

Farmer's capacity-building for ware potato production

From 2004 to 2011, over 40 000 ware potato farmers from all the major potato-producing areas were trained. Group training sessions covered ware potato production technologies and the “Select the Best” positive selection (PS) methodology. Capacity-building was made possible thanks to financial support from the Government, GIZ-PSDA, USAID, CFC and others in conjunction with the MoA through the DAOs. Over 50 percent of the farmers trained were women.

Training activities were facilitated mainly by MoA extension agents, and in some cases farmer trainers were trained using the TOT (Training of Trainers) approach. At the TOT workshops, group facilitators received intensive theory and practical training covering field multiplication, disease and pest identification and management, farm hygiene, seed production, post-harvest technologies and PS techniques. The trainers were given a set of books on PS and other resource material explaining ware and

seed potato production in detail, as well as picture books for the identification of important pests and diseases.²

PS training for ware potato farmers was conducted following the “Select the Best” trainer’s manual. The overlying principle of PS is for farmers to improve and maintain the quality of their own, farm-saved seed. This involves selecting and pegging healthy looking plants in the farmer’s field during plant growth, harvesting them separately and then using the tubers as seed for planting. This is critical considering the limited availability of quality seed potatoes and the high cost of the available seed potatoes. The hands-on training methodology covers eight modules over a period of two crop seasons (Table 5).

During the first season (Modules 1–3), farmers learn the symptoms and control measures of major potato pests and diseases. They also learn how to identify and peg healthy plants from which they obtain their own farm-saved seed. During the second season (Modules 4–8), farmers learn through hands-on establishment of experimental trials/plots comparing unselected farmer-practised seed with PS seed and certified seed.

By adopting PS techniques, trained farmers have been able to improve the quality of their own-saved seed potatoes by reducing the levels of BW and viruses. Results from 25 farmer groups (FGs) that completed the PS training in two districts demonstrated that positive seed selection improves seed quality and increases productivity by 10 to 40 percent. This is crucial, given that about 95 percent of smallholder potato farmers in Kenya recycle

their own harvested tubers or buy them (usually unselected) from their neighbours.

Awareness-raising about seed potato quality and improved varieties

From 2004 to 2011, demonstration plots were established and open days, field days and seed trade fairs organized to raise awareness and educate farmers on the importance of using high-quality seed potatoes and the desired attributes of improved varieties for boosting potato production. The press and media were involved, with local FM radio and national television stations playing a major role in educating farmers in improved potato technologies.

Legislative, institutional and regulatory framework

To promote productivity, the Government has developed laws, policies and strategies to create an enabling environment for effective participation of both the public and the private sector. The potato subsector is affected by several acts: Agricultural Act (Cap. 318), Plant Protection Act (Cap. 324), Noxious Weeds Act (Cap. 325), Pest Control Product Act (Cap. 346) and State Corporation (Cap 446), and is governed specifically by Legal Notice No. 44 (2005) and Legal Notice No. 113 (2008) formulated in the last 10 years. At regional level, ware potatoes are affected by East Africa Standard (EAS) 748, fresh potato tuber (ware potato tuber) – Specification (2010), formulated in accordance with the East African Standardization, Quality Assurance, Metrology and Testing Act, 2006 (EAC SQMT Act, 2006).

TABLE 5

The PS modules, their objectives, crop stages and time needed to complete the lessons

Module	Objective	Crop stage	Time (hours)
0	Group formation	Germination	2
1	PS: select healthy plants in field	1st flowers (6–8 weeks after emergence, WAE)	6
2	Check the health of selected plants	Full flowering (2–3 weeks after module 1)	2
3	Harvesting	Full maturity	4
4	Planting the experiment (compare)	Planting	4
5	PS: Select 200–400 plants	1st flowers (6–8 WAE)	2
6	Field day: recruit interested groups	1st flower (a week after module 5)	4
7	Harvest the experiment, compare yields	Full maturity	4
8	Evaluation and graduation: present and discuss results, award certificates	Soon after harvest	2

Source: PS manual

² PS training documents included: a trainer’s manual, the *Farmer’s Field Aid Booklet*, a picture book and the *Late Blight Field Aid*. To enhance the training, the *Late Blight Field Aid* and *Farmer’s Field Aid Booklet* were translated into Swahili.

Inputs, financing, credit and insurance

Compared with seed farmers, a small number of ware potato farmers have benefited from *Kilimo Biashara* (see above) by obtaining low interest loans. Many farmers, however, have benefited from government initiatives helping farmers to procure affordable fertilizers, such as the voucher system facilitated by DAOs under NAAIAP.

In 2007, the Government launched NAAIAP (National Accelerated Agricultural Inputs Access Programme) and it was administered by the MoA. The Programme aimed to promote food security, agricultural input use, input market development and agricultural productivity, with a special focus on maize (the staple food in selected districts). However, due to high demand, the benefits have spilled over to other crops and other districts. Consequently, it has benefited potato farmers in districts where potatoes are the main crop, thereby reducing the cost of production. In Kuresoi District, one of the leading potato-producing districts in Kenya, 643 potato farmers received certified seed potatoes from ADC-Molo in 2009–2011.

Regional integration and trade

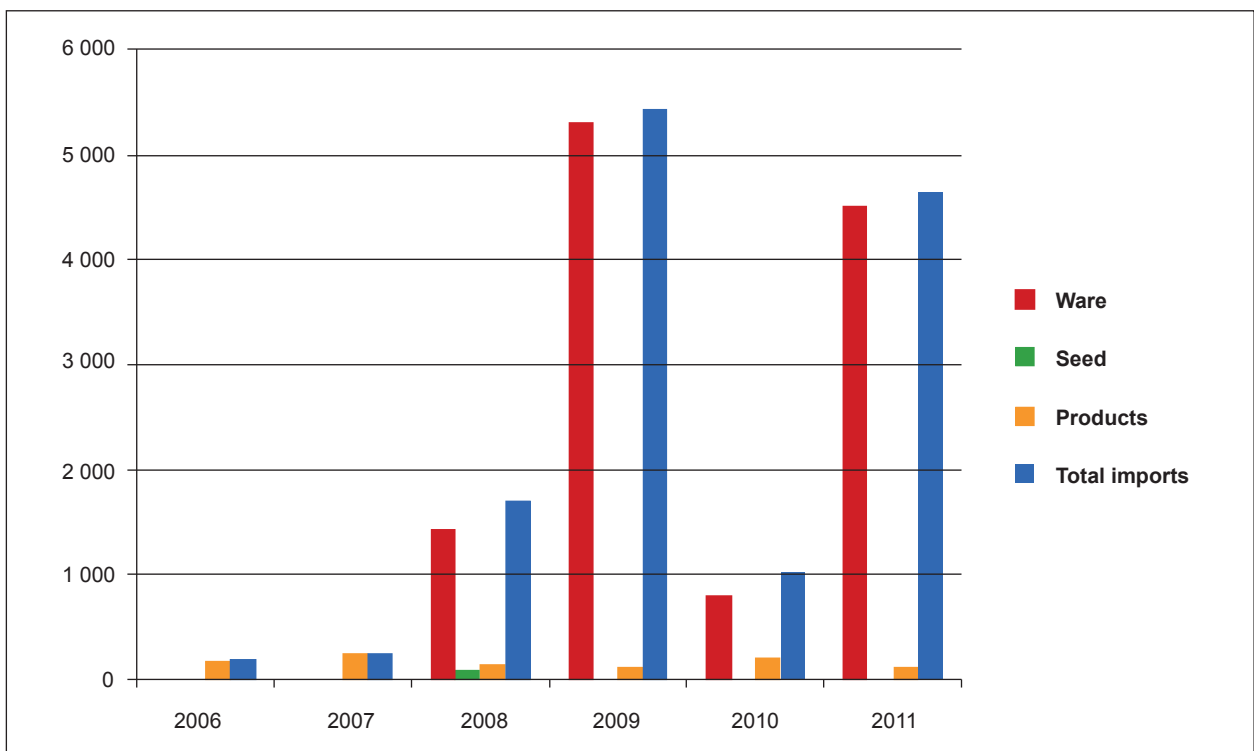
Although most of the ware potatoes produced in Kenya are consumed fresh or processed locally, a small amount of ware potatoes are exported to various countries within and outside the EAC. Similarly, Kenya imports a small quantity of ware potatoes mainly from the United Republic of Tanzania, specifically during March and April when supplies are limited in Kenya since production is mainly rainfed. Between 2008 and 2011, Kenya imported about 10 000 tonnes of ware potatoes from the United Republic of Tanzania. During the same period, it exported fewer than 1 000 tonnes of ware potatoes (Figures 9 and 10). The gazettement of EAS is expected to enhance cross-border trade of seed, ware and potato products.

Marketing infrastructure

Marketing of ware potatoes in Kenya often involves several players, including producers, brokers, transporters, wholesalers, processors, retailers and consumers. An estimated 80 percent of marketed ware potatoes are sold through itinerant brokers who

FIGURE 9

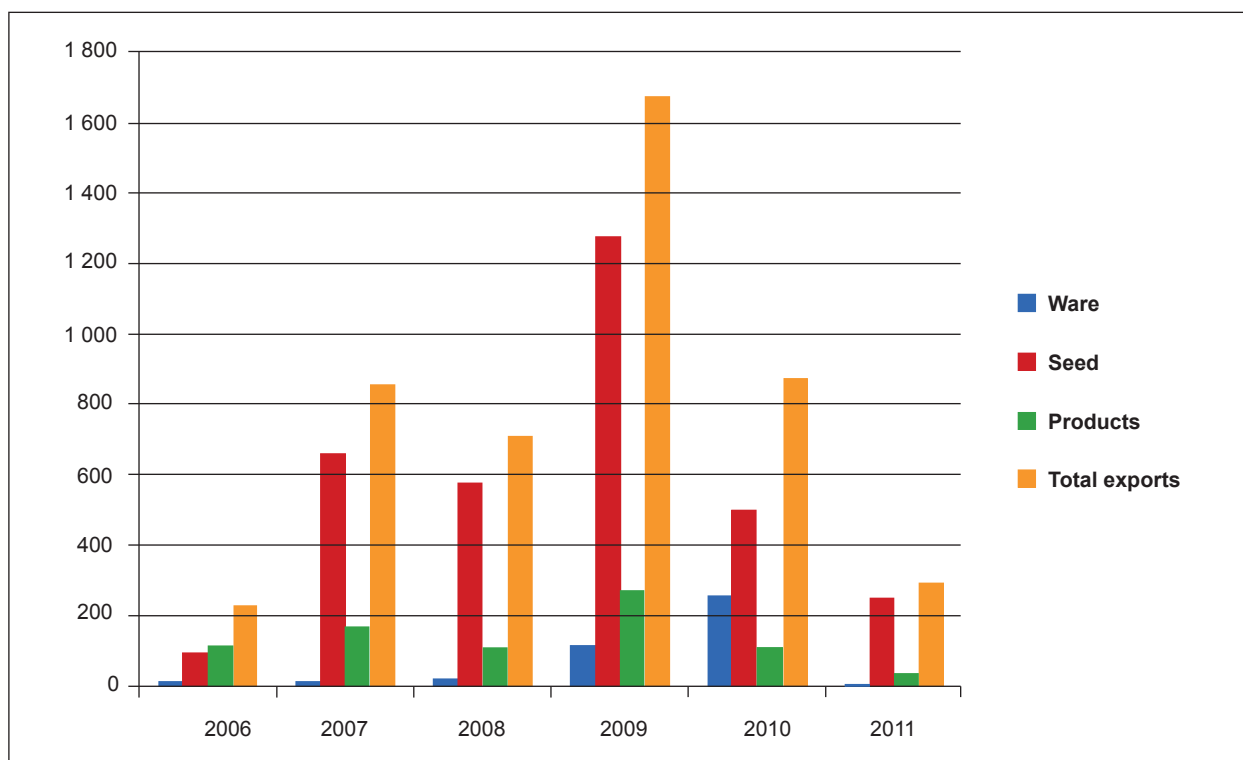
Quantities (tonnes) of seed, ware and potato products imported to Kenya, 2006–2011



Source: Ng'anga and Kaguongo, 2012 (adapted)

FIGURE 10

Quantities (tonnes) of seed, ware and potato products exported from Kenya, 2006–2011



Source: Ng'anga and Kaguongo, 2012 (adapted)

arrange shipment of the tubers to wholesalers in urban markets. These rural traders base the prices they offer potato producers on prevailing supply and demand conditions at the point of resale and not on the growers' production costs. Farmers are often frustrated by their inability to influence potato prices: as harvests are determined by rainfall conditions and they often have neither the storage facilities nor the liquidity to enable them to postpone sales, they feel forced to present their tubers for sale and accept the terms of sale offered by the traders.

Access roads to most potato-producing areas are very poor, hindering transportation, especially during the rainy season. Furthermore, most marketing facilities provided by local authorities at county, municipal and city level are unsuitable for marketing fresh potatoes. Public open air marketing facilities are typically uncovered and potato products are subject to damage by the sun, rain or mud. Currently, the MoA through the Smallholder Horticulture Marketing

Programme (SHOMaP) is renovating access roads and constructing pilot storage facilities and collection centres to help address these marketing challenges. GIZ-PSDA and NPCK are working in partnership with SHOMaP to assist in capacity-building and training of farmers in management and operations of the pilot storage and collection centres.

Linking ware producers to seed producers

The concept of value chain promotion has taken centre stage in recent years (2004–2011). Trained seed potato multipliers have been linked to basic seed potato producers, such as KARI-Tigoni and Kisima Farm. The secondary seed potato multipliers are in turn linked to the trained ware potato farmers. With the development and consolidation of these supply-side linkages and the organization and promotion of demonstration plots, open days, field days and seed trade fairs, seed potato multipliers are able to sell all their seed at the farmgate without incurring storage or transport costs.

Linking ware potato producers to markets through contract farming

While the presence of a stable and growing market is critical for producers, the timely and regular supply of quality raw material is essential in order for processors to meet market requirements. For contract farming to work, mutual trust must be developed between the different parties. In Kenya, the concept is well established in the horticultural sector, but it is fairly new in ware potato farming. As with any new technology or system, potato contract farming has had problems but it has also had numerous successes:

- In 2004, trained ware potato farmers from Narok North District were linked to fast food restaurants and hotels in Nairobi.
- In 2009, with the financial support of CFC in partnership with KARI-Tigoni, CIP and MoA, trained ware potato farmers from Bomet District were linked through contract farming to Deepa Industries, a private potato processing company, and the initiative successfully engaged over 350 households in contract farming.
- In three years (Sept. 2009 – Sept. 2011), contracted farmers delivered over 1 300 tonnes of quality ware potatoes worth about USD 9 000.

Both parties benefit from the contractual arrangements: the farmer receives better prices from an assured buyer than on the open market; the processor has better conversion rates, thanks to the improved quality (losses due to immature, broken and rotten potatoes are reduced). This has, in turn, meant higher returns to potato production, resulting in increased household incomes (in some cases doubled) from potatoes. Additional benefits of contract farming include better access to credit facilities from the processor and financial institutions (in particular the Equity Bank), regular extension advice and coordinated transport arrangements.

4.4 Potato products

With urbanization and a growing tourist industry, the demand for processed potato products in Kenya is rising. Large companies (Njoro Canning and Midlands) produce frozen potato chips for sale in leading local supermarkets and for export. Limited processing varieties, poor packaging and transportation, lack of traceability, limited processing technologies and inadequate and irregular supply of quality tubers are the main bottlenecks restricting potato processing in Kenya. 'Dutch Robjin' is the only processing variety grown by a significant number of farmers, mainly in Bomet and Narok counties. However, the variety is highly susceptible to late blight and is low-yielding. Hence, not many farmers in other potato-growing counties are prepared to grow it without being guaranteed a premium price. Poor post-harvest management practices result in low-quality potatoes on the market; processors therefore prefer imported potatoes, which, although more expensive, are of good quality. The last five years have therefore seen imports of potato products surpass exports – with the exception of 2009 when exports were much higher than imports.

A range of interventions are possible to promote industrial potato processing:

- research and development of processing varieties
- provision of seed for existing processing varieties
- farmer training in production techniques and raw material specifications for processing
- introduction of contract farming

Two of the three varieties released in May 2010 ('Sherekea' and 'Purple Gold') are suitable for processing, and production of quality seed is underway. Also, several advanced clones with processing traits are currently being evaluated by KARI-Tigoni in collaboration with CIP, universities and other organizations.

5. Evaluation and impact analysis of potato subsector interventions

Policy recommendations and options to promote growth of the potato subsector and meet the challenges of diversification in Kenya



Locally-made processed potato products

5.1 Positive factors

Consumer and farmer preference

Although yields appear to have declined sharply over the last decade, harvested area has increased. Potato consumption continues to gain popularity in the country with annual per capita consumption estimated at 29.5 kg, and it is expected to rise due to increased consumption by urban dwellers and the fact that unlike maize, it is not prone to aflatoxins. The potato is efficient in terms of conversion of natural resources to nutrients per unit of area and time. It is, therefore, a good pro-poor crop due to its high yield potential, especially in Kenya where fragmentation of farms has led to smaller-scale producers. The ability to outyield other crops under highland growing conditions, its high nutritive value and short growing season are some of the attributes making the potato an attractive crop for meeting smallholder food and cash needs.

Government recognition of the potato as a food security crop

The potato's potential contribution to resolving the problem of hunger has been recently promoted by the Kenyan Government. The crop is in a good

strategic position in terms of budgetary allocation and implementation of policies, and productivity should therefore be improved.

Improved technologies and innovations

The most important problem in potato productivity is unavailability of quality planting material. However, with the adoption of improved technologies (e.g. aeroponics and intensive greenhouse mini-tuber production) the rate of seed multiplication is expected to increase by about 30 percent. Furthermore, widespread dissemination and adoption of “clean seeds”, the equivalent of quality declared seeds (QDS) and positively selected seed (PSS), can help farmers improve yields by over 30 percent.

Niche market development

Although the main points of sale for potatoes are public open markets, other niche markets are emerging (e.g. supermarkets and direct supply to processors). Furthermore, supermarkets are increasingly important outlets for the sale of processed potato products. Farmers should, therefore, be empowered to supply these new niche markets so that they can obtain premium prices for good-quality raw material, rather than the undifferentiated prices offered in open markets.

Institution strengthening

An important development in the potato subsector is the marked increase in the number of actors and players, especially in the private sector, and the improvement of institutional capacity in the public sector. The formation of the KENAPOFA and the NPCK, the growing number of potato processors and the adoption of aeroponics technology by private sector players are just some of the most prominent indications that private investors have realized the potential of the crop. There have also been increased potato activities in public institutions after a slight increase in government funding.

5.2 Constraints

Inefficient production systems

The informal seed system supplies over 90 percent of seed in Kenya; this means that tubers may harbour seed-borne diseases and the varieties grown sometimes have a low-yielding genetic potential. This system is characterized by use of degenerated farm-saved seed for planting the following season. It continues to prevail because there is limited knowledge of the formal seed system, which moreover is inefficient in its production and distribution of good-quality seed. The result is that many farmers grow their own “farmer varieties”, currently estimated to number over 60. Overreliance on rainfed production has also contributed to a system characterized by recurrent gluts at harvest, followed soon after by shortages during the cropping season. This problem is exacerbated by lack of storage facilities, and limited access to credit, technology and know-how.

Competitiveness

Average potato yields in Kenya have not only declined, they remain low (< 5 tonnes/ha), comparing poorly with the average yields for all of Africa (10.8 tonnes/ha), Europe (17.4 tonnes/ha) and North America (41.2 tonnes/ha). Low productivity means poor returns to capital and labour, given the low farmgate prices of potatoes at harvest. Potato production in Kenya is, therefore, less competitive than other crops and potato products from other countries.

The quality of potatoes available in the market is poor. They are not suitable for processing – because of lack of appropriate varieties and as a result of poor post-harvest handling and storage. Premature and poor harvesting, transportation, storage and handling methods contribute to lowering the quality of marketed potatoes. This has led to fast food restaurants (e.g. Kentucky Fried Chicken and Nando's) importing frozen chips from Egypt and South Africa.

Low production and use of quality seeds

Production and use of high-quality seed remains low. This may be due to low awareness, poor distribution, availability of credit and other complementary inputs (e.g. fertilizer). Scarcity of good-quality seed remains a major constraint to improved potato production.

Poor marketing system and infrastructure

Potatoes are currently marketed through a fragmented chain, characterized by a high number of handlers, lack of integration, and marketing and market inefficiencies, all of which result in high supply risks, high transaction costs, price fluctuations and loss of quality. Traders face enormous challenges in the logistics of marketing, physical infrastructure and market information. Structures and facilities provided for marketing potatoes in urban, municipal and city markets are inappropriate for fresh produce.

Lack of adherence to guidelines and regulations

Although guidelines and regulations on potato standards for production and marketing exist, they are largely not enforced. The MoA's Legal Notice No. 44 of 2005 offers guidelines for potato production, harvesting, sorting, grading, packaging and marketing requirements, but these are largely not adhered to by subsector participants. Similarly, Legal Notice No. 113 of the Ministry of Local Government prohibits the marketing of potatoes in bags exceeding 110 kg in weight. However, this packaging standard is not strictly adhered to, nor actively enforced.

Insufficient use of ICT

There is little use of ICT (information and communications technology) in the potato industry. Communication in potato marketing is mainly by telephone and mobile phones are the principal mode of communication between traders in major urban centres and middlemen in production areas. This does not, however, result in farmers getting higher prices for their produce; on the contrary, it gives middlemen and traders an advantage when discussing the terms of sale. Where communication networks are poor, farmers, brokers and traders rely mainly on word of mouth.

Limited value addition

Value addition at all levels of the potato value chain remains limited, despite the expanding food processing industry (spurred by the growth of the urban population), the changing age structure of the population, the shift in eating habits, tastes and preferences, and increased tourism. There are constraints to the increase in value addition: insufficient varieties for processing, lack of

technologies and limited appropriate technical know-how. Old varieties, such as 'Kerr's Pink' and 'Dutch Robbin' (good for crisps) and 'Roslin Tana' and 'Nyayo' (good for chips), are highly susceptible to late blight and viruses. This affects their productivity and the quality of the final processed product, which in turn reduces the competitiveness of a value-addition-based business.

Inadequate staff and limited financing

The industry receives little attention in terms of extension services, due to inadequate staff and limited financing. There is no significant private sector or civil society involvement in extension service delivery for the potato. Most potato research is undertaken by the public sector in KARI-Tigoni, in collaboration with CIP, local universities, agrochemical companies, processors, farmers and KEPHIS.

5.3 Challenges and opportunities

Population growth and evolving urban eating habits

The rapidly increasing urban population is a challenge to food security in Kenya. The large urban population is becoming a major potato consumer, stimulating demand for ware potatoes and processed products. The eating habits in urban homes and institutions are also changing, bringing about increased demand for processed potato products. There is an increasing need for fast-cooking foods requiring little fuel and preparation time. This also necessitates investment in pre-cooking methods to produce food items which need minimal cooking before serving.

Consumer awareness

Consumers have shown increased demand for both quality and quantity of processed products; processors have therefore had to improve their goods and search for new products and standard packaging methods. Currently, food safety and traceability are a requirement and affect competitiveness along the food value chain. Farmers should be taken through capacity-building processes to adopt traceability as an integral part of potato production. If not, they will lose business opportunities to other countries such as South Africa and Egypt who have incorporated traceability in their production systems.

Consumers must be made aware – or reminded – that potatoes need to be cooked with their skins

intact to avoid a large part of their nutritional content becoming lost during preparation.

Fluctuating farmgate prices

A major challenge in sustainable potato production is seasonality, which leads to lower farmgate prices (by up to 50 percent). To overcome this problem, farmers should be encouraged to invest in irrigation, ware potato storage, collection centres, a warehouse receipting system and contract farming.

Recent potato technologies

Opportunities brought about by recent technologies in potato production (e.g. aeroponics and positive selection) can spur the industry to a new level. However, adoption of these potato technologies is a challenge due to farmers' cultural and socio-economic background.

Inadequate policies and limited enforcement of existing policies

There is poor enactment of existing potato policies in their legal framework due to the unclear responsibilities of implementing agencies. For example, the application of Legal Notices No. 44 and No. 113 is hampered by the lack of a clear strategy between the Ministry of Agriculture, the Provincial Administration and the Ministry of Local Government. Extended bags (130–260 kg) continue to find their way to market. Although the NPCK is overseeing the implementation of the legal notices, it needs legal backing to overcome barriers laid down by interested parties such as middlemen.

Poor agronomic practices

The majority of farmers use farm inputs (e.g. fertilizers and fungicides) and adopt production practices (e.g. spacing and crop rotation) which are not in line with technical guidelines. Agronomic recommendations need to be researched and reviewed to correspond to varying ecozones and to match changing environmental and farm-level circumstances. The current low yields and low returns are a wake-up call to invest more in the development of appropriate agronomic technologies.

High disease and pest incidence

Reduced farm size, use of poor-quality seeds and continuous cropping have led to disease buildup in the major potato-growing areas. Service providers

have trained farmers to adopt simple and low-cost techniques (e.g. positive selection and seed plot practices) to counter disease problems, but diseases persist. It is necessary to explore zoning for production of seed and ware potatoes as a strategy for the eradication of diseases (in particular, bacterial wilt). Also, breeding for resistance to late blight and BW should be strengthened and fast-tracked.

Limited choice of varieties

Processing of potato cultivars can increase thanks to collaborative efforts by CIP and KARI-Tigoni, offering the opportunity to hasten varietal release to meet demand through joint breeding and evaluation processes. The introduction and dissemination of varieties suitable for specialized use and of varieties adapted to lowlands should be fast-tracked.

High post-harvest losses

Unstructured marketing channels, insufficient infrastructure and poor GAP for both seed and ware potatoes lead to high post-harvest losses due to the perishability and bulkiness of the crop. Improving the marketing system, in particular market infrastructure, will help reduce these losses. Research into post-harvest losses along the potato value chain should be undertaken urgently.

Regional integration and trade in seed and ware potatoes

The gazettement of EAC standards (EAS) is seen to enhance cross-border trade of seed, ware potatoes and processed potato products. Adoption of the harmonized EAS will increase the potato's competitiveness – given the comparative advantage that EAC member countries have over countries outside the community – and enhance business opportunities for investors in the potato industry.

Subsector development plan

The lack of a road map to guide the potato industry in terms of required infrastructure, resources (human and financial), policies and legal framework is a challenge. The existence of other documents – Seed Potato Master Plan, Potato Policy Framework, Task Force Report, Legal Notice No. 44 (2005) and Legal Notice No. 113 (2008) – offers an opportunity for consolidation and development of a subsector development plan.

5.4 Lessons learned

Rapid seed multiplication technologies and the role of PPP

Public-private partnerships in technology development, introduction and uptake are crucial for promoting growth of the potato subsector. Partnerships in basic seed production, the introduction of varieties and production technologies (aeroponics and hydroponic systems), and the accelerated diffusion of technologies all increase farmers' access to new varieties. Projects implemented by the private sector in the recent past have not only increased production of quality seed but also brought in efficiency, timeliness, mechanization and improved production and accessibility of seed potatoes. Overall, the private sector contributed over 80 percent of both mini-tubers and basic seed produced in 2010 and 2011.

Capacity-building of extension staff, seed multipliers and decentralized seed production

Training of extension staff and seed multipliers, as well as decentralized seed potato multiplication to potato-producing counties, have successfully increased the availability of seed and reduced the cost of accessing it. Furthermore, the decentralized seed multiplication farms act as demonstration fields, helping farmers see for themselves the positive effects of good-quality seeds. Farmers believe what they see and feel: hands-on treatment and experience encourage the adoption of a technology.

Legislative, institutional and regulatory framework

ASARECA recently supported the harmonization of seed policies and regulations. The EAC seed potato standards were finalized in 2011, together with those for ware potatoes and products. The gazettement of EAC standards is expected to enhance cross-border trade of seed potatoes, although the amount of seed traded is quite low. To promote potato productivity, the Government has developed several laws, policies and strategies to ensure an enabling environment for effective participation of both the public and the private sector. Harmonization of this legislative, institutional and regulatory framework is vital for the development and smooth running of the industry.

Inputs, financing, credit and insurance

The high cost of farm inputs (in particular seed, fertilizers and agrochemicals), the inaccessibility of affordable credit facilities and unpredictable weather patterns have led to low potato productivity. Ensuring that farmers have adequate access to financial resources is a key component of an overall effort to improve crop productivity.

Climate change adaptation

In the face of climatic variability, the need for adaptation strategies cannot be underrated. The introduction of an agricultural index insurance, *Kilimo Salama* (safe agriculture), in 2008 was therefore seen as a step in the right direction. The initiative, the first of its kind in Kenya, was fronted by the Syngenta Foundation for Sustainable Agriculture in partnership with UAP Insurance and Safaricom. It aims to provide smallholder farmers with simple, affordable and relevant insurance policies. As a result of these interventions (capacity-building, introduction of novel seed technologies and practices), production and accessibility to basic seed has improved, and production of, accessibility to and use of certified seed and good-quality seed have increased. The promotion of low-cost seed potato storage is a good strategy for making well-sprouted seed available for the next planting season, allowing farmers to have a crop within two months of planting and avoid the effects of insufficient rainfall.

Benefits of contract farming

- Adherence to the standard bagging of 110 kg
- Increased competition in local potato markets – local buyers, such as vendors, pay almost the same price as those offered under the contract
- Advantages for both parties – the processor gains from the improved quality resulting in improvements in conversion rates from raw material to finished product, the farmer gains from higher, guaranteed prices
- Increased profitability compared with independent production
- Improved access to credit facilities from processors and financial institutions (in particular the Equity Bank)
- Regular extension advice
- Coordinated transport arrangements
- Promotion of farmer associations – can help capture economies of scale in the purchase of inputs, provide extension

Seed demand still to be met

Although considerable progress has been made over the last five years in seed production, the amount of seed potatoes available for ware growers is still well below national requirements. Investment in a seed system is therefore crucial for the improvement of potato production. Seed potatoes account for over 40 percent of the cost of ware potato production in Kenya and reducing this cost would improve potato profitability. Efforts to develop a protocol for the production and trading of clean seed as QDS and its legalization should be given priority in order to increase access to relatively cheap, but reasonably good seed.

Farmer's capacity-building on ware potato production

The experience gained in recently implemented projects has shown that when potato farmers are trained in the use of potato improvement technologies, such as PS and maintenance of their own-saved seed, potato productivity increases by between 10 and 40 percent.

Linking ware producers to markets through contract farming

The presence of a stable and growing market is critical for producers; likewise, a timely and regular supply of quality produce is essential if market requirements are to be met. Contract farming is based on the development of mutual trust between the different parties. Both parties benefit from the contractual arrangements: the processor gains from the improved quality (improved conversion rates of raw material to finished product, thanks to reduced processing losses caused by immature, broken and rotten potatoes); the farmer obtains higher prices from an assured buyer than those offered in the open market (as a consequence, there are higher returns for potato cultivation).

Access to credit and extension through contract farming

Contract farming also facilitates access to credit facilities from processors and financial institutions (in particular the Equity Bank), to regular extension advice, and to coordinated transport arrangements. The Government should promote contract farming by developing the necessary legislation and providing financial support.

5.5 Conclusions

The potato has not been highly prioritized in Kenya's agricultural development policies for food crops, despite its importance as a staple food and its potential contribution to combating hunger and poverty. The potato can make an important contribution to economic growth and the improvement of the welfare of poor households; nevertheless, the potato subsector faces numerous complex challenges, including:

- low yields, high incidence of disease, lack of suitable varieties;
- limited production, distribution and use of quality seeds;
- fragmentation of actors and players with uncoordinated activities;
- low added value and limited agribusiness activities;
- improper agronomic practices, ineffective and inappropriate disease control measures; and
- pre- and post-harvest management problems (harvesting of immature tubers, insufficient or no tuber curing, poor handling of tubers, inappropriate packaging, poor or no storage, inefficient and exploitive marketing practices).

Low productivity means foregoing income gains (possible only if farmers achieve 25-tonne/ha yields by adopting available technology). Losses along the value chain – estimated at 15–40 percent – also cut into profits and reduce the volumes available for consumption. Changing weather patterns have resulted in increased frequency of droughts or occasional excessive rains in traditional potato-growing areas, both of which damage seed and ware potato production. A notable increase in disease and pest infestation has also been observed in production zones traditionally suitable for seed production as they previously had low disease and pest infestation.

In the recent past, efforts have been made by the Kenyan Government, stakeholders and development partners to address some of these challenges in order to accelerate the subsector's growth and development. Initiatives include:

- introduction of rapid seed multiplication technology (e.g. aeroponics);
- training in the use of alternative seed production methods (clean and positively selected seeds);
- private sector involvement in basic seed production; and
- formation of the multistakeholder NPCK and PPP platform.

The NPCK is responsible for planning, organizing and coordinating value chain activities with the aim of developing the subsector into a robust, self-regulating and competitive industry.

Seed systems and variety development

The use of high-quality seed is key to unlocking the potential of the subsector, but it is limited to less than 5 percent of all growers. Over 95 percent of potato farmers depend on their own seed selected from tubers harvested in the previous growing season. Lack of knowledge, short supply and poor distribution of certified and clean seed have all contributed to the very limited use of high-quality seed. Despite recent interventions, shortage of seed persists because the quantities of seed produced by the potato programmes are small and do not reach all interested farmers. Proposals to help bridge the shortfall in seed supplies by importing seed have generated considerable controversy in the industry especially where phytosanitary issues are concerned. If importation is to be allowed, it needs to be handled according to the strictest observation of phytosanitary standards.

Critical interventions in seed systems and varietal development include:

- enhancement of quality control laboratories for germplasm clean-up and conservation;
- seed quality assurance; and
- in-house seed quality testing to ensure that seed is disease-free.

Investment in research on new technologies for rapid seed multiplication (e.g. aeroponics) and biotechnology should be enhanced. Accreditation of private sector participation in seed certification will help increase the production of certified seed. The

development and the introduction of varieties for specialized use, including processing and lowland production, are also long overdue.

Ware potato production

Potato production in Kenya is mainly under rainfed conditions, and most farmers use poor production and post-harvest management practices that reduce the quantity and quality of marketed potatoes. Low-quality seed, low input use, and prevalence of pests and diseases are some of the main constraints leading to average yields of 10 tonnes/ha or less (compared with yields of 25 tonnes/ha if good crop husbandry practices are adopted).

Currently, potato production is concentrated at altitudes above 1 500 m, but there are also opportunities for potato cultivation in ASAL regions if the constraints are overcome: absence of irrigation infrastructure combined with lack of lowland varieties and the accompanying agronomic techniques.

Potato marketing and processing

Potato marketing channels are poorly structured and farmers, who are rarely organized, generally get low returns. There are numerous constraints:

- high perishability of potatoes
- lack of adequate storage facilities
- poor access roads
- poor marketing infrastructure
- lack of implementation of quality standards
- inadequate access to market information

Although there has been increased demand for both better quality and greater quantity of processed products, increasing value addition in potato marketing has been handicapped by unstable supplies of low-quality raw material.

Policy, legal and regulatory framework

Several acts of parliament and legal notices from various ministries govern production, marketing and processing of potatoes, but implementation is a challenge. Documents include the Root and Tuber Policy, Potato Strategy, Potato Industry Strategy (2005–2014) and Seed Potato Master Plan (2009–2014). They need to be reviewed and updated to reflect the current situation, respect international laws and meet the latest guidelines. Partially implemented regulations and legal notices include Legal Notices No. 44 (2005) and No. 113 (2008), which address grading, sorting, packaging and transportation of seed and ware potatoes.

5.6 Policy recommendations

Policies, innovations and planned efforts should aim to transform the potato subsector from its current semicommercialized, uncompetitive and low productivity status, characterized by low yields (< 10 tonnes/ha), low agribusiness (< 10 percent), moderate employment (3.3 million), moderate income (KES 13 billion [USD 150 million]) and low diversification, to a robust, competitive and self-regulating industry, characterized by high yields (> 25 tonnes/ha), high agribusiness (> 80 percent), high employment (6.6 million), high income (KES 150 billion [USD 1.7 billion]) with both vertical and horizontal diversification. Specific policy recommendations and policy options required to spur the growth of the potato subsector and meet the challenges of diversification in Kenya are outlined overleaf.

Ware potato production

Promote and facilitate the use of improved-quality seed.

Encourage and enable investments in irrigation infrastructure in traditional potato-growing areas to reduce the climatic risks associated with rainfed production and mitigate the effects of climate change.

Advocate good soil and water management practices to increase potato productivity.

Increase access to affordable credit and financial services.

Promote reduction in size of the potato bag from the current 110 kg to 50 kg to be in line with EAS and with ILO (International Labour Organization) recommendations, of which Kenya is a signatory.

Form and strengthen smallholders' organizations to:

- improve and increase farmers' bargaining power by capturing economies of scale; and
- facilitate and leverage production and marketing information flow.

Promote municipal government and private sector investments in basic market infrastructure in open-air public wholesale and retail markets: covered areas, secure short-term storage, paved central squares.

Encourage private and public sector investments in collection centres and warehouse receipting systems in order to:

- even out supply of ware potatoes over the year;
- encourage farmers to store (receipting system);
- add value through storage (time utility); and
- reduce volatility of ware potato prices over the seasons.

Reform and regularly review the preparation and dissemination of basic subsector statistics on production, area harvested, yields, prices per actual quantities sold and quantities unloaded in major urban markets, in order to present a more consistent, accurate and useful set of information on the performance of the subsector over space and time, and thus facilitate both public sector planning and private sector investments in potato-related activities.

Establish an information platform with links to other Web sites to serve as an access point for the abundance of research reports, scientific articles and government reports on the potato subsector that are not otherwise readily available in a single location.

Implement a systematic campaign to construct all-weather feeder roads linking major potato-growing counties to national highways and urban consumption centres.

Launch promotional campaigns, regional and seasonal gastronomic fairs and competitions (in collaboration with high profile retailers, hotels and restaurants, secondary schools, training institutes, and provincial and municipal governments) involving the preparation and consumption of potatoes with their skins, in order to educate the general public about reaping the full nutritional benefits of cooking and eating potatoes.

Promote the introduction, development and dissemination of varieties that respond to the need of the industry and prevailing circumstances with the aim of:

- addressing climate change;
- making varieties available for specialized use (e.g. processing), including early-maturing, drought-tolerant and lowland varieties; and
- removing constraints to variety release by promoting public and private sector collaboration in the evaluation of industry-desired varieties where locally developed or imported varieties are easily disseminated.

Seed potato production

Review relevant policies to facilitate characterization and official recognition of farmers' cultivars.

Review the Seed and Plant Varieties Act (Cap. 326) to enable:

- certification of potatoes in the form of *in vitro* plantlets and mini-tubers;
- recognition of and development of standards for QDS;
- reduction of the packaging of seed potatoes to smaller quantities (e.g. 10 or 20 kg) to promote widespread use of good-quality seed by small farmers; and
- participation of both the public and the private sector through PPP in seed inspection and certification, possibly through accreditation.

Promote availability and use of certified seeds by:

- developing and using new and efficient technologies for variety development and seed production to suit various climatic conditions (e.g. early-maturing) and utilization needs (e.g. specific starch content, shape, colour); and
- promoting the availability of and accessibility to good-quality seed by strengthening linkages between informal and formal seed systems.

Explore the establishment of "strategic reserves" of seed potatoes by promoting the use of:

- cold storage or improved storage facilities;
- DLS using locally available materials; and
- *in vitro* conservation of plantlets.

Involve stakeholders and a wide range of relevant specialists in the evaluation and formulation of policy guidelines on subsector issues related to national food security and after undertaking relevant studies (e.g. risk of pest and disease infestation, economic and environmental analysis).

Create and strengthen linkages and networking among potato research institutions, extension and seed producers (public and private) through a seed platform within the NPCK.

Promote availability and use of certified seeds through development and use of new and efficient technologies for varietal development and seed production (including research in modern biotechnology) to suit various climatic conditions and specific end uses (e.g. high starch content and preferred tuber shapes).

Promote and invest in irrigation infrastructure to ensure research continuity and to increase seed availability in order to mitigate the frequent droughts brought about by climate change.

Allocate increased funds for supporting human resource and infrastructural development for potato research through PPP. The revolving fund for seed potato production should be actualized (at KARI-Tigoni) by developing terms and guidelines for its operation under the supervision of a stakeholder committee.

Encourage existing and new financial institutions to develop appropriate financial packages for seed growers.

Promote the formal seed sector through capacity-building of the private and public sector (starting with seed merchants, including ADC) by providing incentives and seeking active participation of grower organizations to ensure sufficient production of high-quality, disease-free seed and to eliminate sale of breeders' seed directly to farmers.

Develop and promote innovative seed potato distribution to ensure availability and access to all interested farmers.

Processed potato products

Promote good manufacturing practices (GMP) by developing GMP for various potato products.

Counter the negative perception of the potato as “unhealthy” through promotional campaigns on the nutritional and health advantages of properly prepared potatoes and potato products.

Facilitate evaluation and release of varieties for specific product niches according to processor demand.

Promote production and adoption of preferred processing varieties and encourage investment in processing capacity.

Improve quality of tubers for processing through agronomic and post-harvest research (e.g. carry out a baseline study of the effective costs of peeled and cut fresh potatoes versus pre-cooked frozen chips – whether locally produced or imported).

Promote PPP in potato processing by offering incentives to investors to set up processing plants within production areas.

Establish a mechanism – possibly through KENAPOFA – that encourages farmers to grow potatoes for processing through contractual arrangements.

Promote increased market access through product diversification, differentiation and enforcement of quality and standards.

Develop mechanisms and legislative support to ensure compliance with producer contracts by all parties.

Enforce laws to reduce acrylamides in fried potato products for consumer safety.

Marketing of seed and ware potatoes

Promote and empower farmers' organizations to more effectively articulate farmers' concerns in production and marketing by ensuring beneficial linkages among all the players in the potato value chain.

Promote PPP in marketing of potatoes through the development of a marketing infrastructure (including physical infrastructures) to increase market access for farmers.

Continuously review and enforce existing potato standards for both local and export markets.

Increase access to market information through increased use of ICT by creating collaboration between the public and the private sector, including potato growers' organizations.

Promote production and adoption of preferred varieties and encourage investment in processing capacity.

Build capacity of all players along the value chain on post-harvest handling.

Improve fresh produce markets and install appropriate infrastructure storage technology to bridge the marketing gap between seasons.

Cross-cutting issues

Create effective traceability systems to ensure continuous improvement and informed regulation.

Develop networking, linkages and collaboration among industry actors, players and stakeholders through a central platform (NPCK) and involve the media.

Increase extension services through development of public and private sector partnerships.

Create awareness among policymakers of the subsector's potential to improve incomes, nutritional benefits, processing options and food security and of its contribution to achieving Vision 2030.

Engage policymakers at national and county level in preparing potato development plans and policies to encourage production, processing and consumption.

Promote provision of business development services to producers and producer associations to complement technical training.

Strengthen the NPCK by:

- developing mechanisms and legislative support to achieve financial sustainability for the industry; and
- facilitating its integration into existing institutions at different levels of governance and within the subsector.

Strengthen mechanisms to minimize risks in potato farming through government-subsidized credit (e.g. in coffee, pyrethrum), crop insurance etc.

Develop a national potato development plan to:

- define Kenya's policies and proposals for the development and use of potatoes in the country;
- detail the engagement terms and obligations of all actors, players and stakeholders;
- outline what the country aims to achieve for the industry; and
- provide a blueprint to the targeted status.

Increase government funding and support of the industry, including consistently funding the core national strategic potato research.

Current legal institutional and regulatory frameworks

- Seed and Varieties Act (Cap. 326)
- Pest Control Product Act (346)
- Legal Notice No. 44 (2005)
- Seed Potato Strategy (2009)
- Seed Policy (2011)
- International Seed Testing Association (ISTA) and International Union for the Protection of New Varieties of Plants (UPOV)
- Root and tuber crops policy (draft)
- Harmonized seed policies and regulations in EA (not gazetted yet)

Desired legal institutional and regulatory frameworks

- Create awareness among policymakers of the multiple advantages of the potato
- Strengthen NPCK stakeholder network – integrate into existing institutions at different levels of governance and within the subsector
- Promote and empower farmers' organizations to articulate concerns in production and marketing
- Ensure beneficial linkages between all players in the potato value chain
- Strengthen mechanisms to minimize risk in potato farming
- Provide government-subsidized credit (e.g. in coffee and pyrethrum), crop insurance etc.
- Develop national development plan for the potato subsector
- Set out policies and proposals for the development and use of potatoes and blueprint of how to achieve this
- Strengthen research-extension linkages
- Make available consistent government funding for core national strategic potato research
- Review and enforce existing potato standards for both local and export markets

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