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Review

A review of constraints to ware Irish potatoes production in Kenya

Jane Muthoni[1]* and D. O. Nyamongo[2]

[1]Kenya Agricultural Research Institute (KARI). National Potato Research Centre, Tigoni, Kenya.
[2]Kenya Agricultural Research Institute (KARI). National Genebank of Kenya, Muguga. Kenya.

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Irish potatoes are an important food crop in Kenya, with production volumes only second to maize. Potatoes are produced in the cool highlands mostly by small scale farmers under rain-fed conditions. The soils in these areas are generally acidic and of low fertility due to anthropogenic activities. The national production is far below the potential, largely due to limited use of certified seeds, low application of fertilizers and other organic amendments, and low use of fungicides and other production chemicals. Marketing problems bedeviling potato industry include lack of organized channels in which farmers have no power. The channel is controlled by cartels, which shield producers from receiving any market information. There is a lot of handling and in the process the producer's share in the final price of the commodity is minimal. Transport of potatoes to the market is expensive due to poor road infrastructure in the producing area. Seasonality in production and lack of on-farm ware potato storage lead to minimal returns to farmers.

Key words: Irish potatoes, production, marketing, constraints.

INTRODUCTION

Irish potato (*Solanum tuberosum* L.) is the world's fourth largest food crop after wheat, rice and maize. World production reached a record 320 million tonnes in 2007 and production in the developing countries has almost doubled since 1991, with a corresponding increase in consumption (Hoffler and Ochieng, 2008; FAO, 2008). Potatoes are an important source of food, employment and income in developing countries (FAO, 2008). The potato's high energy content and ease of production have also made it an important component of urban agriculture which provides jobs and food security to some 800 million people globally (Hoffler and Ochieng, 2008). Hundreds of millions of people in the developing countries including Kenya are facing food crisis as the cost of their staple foods continues to rise. Rice prices have almost doubled during the year 2008, as wheat prices are climbing rapidly while maize prices are skyrocketing. But On the contrary, the price of potato has remained stable (Hoffler and Ochieng, 2008). The potential of the potatoes is yet to be fully realized and has never been more evident until the recent rising prices of rice, wheat and maize (FAO, 2008). Potatoes have the potential to relieve the pressure of increasing cereal prices on the poorest people and contribute significantly to food security. Potatoes are grown and eaten locally, with little significant international trade compared to cereals, so they are particularly valuable as food in the developing countries. Potatoes mature in 3-4 months and can yield about 40 tons/ha (FAO, 2008) and hence ideally suited to places where land is limited and labour is abundant (FAO, 2008).

Kenya is the fifth biggest potato producer in Sub-Saharan Africa, with an output of 790,000 tonnes in 2006 (FAO 2008). In Kenya, the crop is second most important staple food crop after maize (MoA, 2005) and plays a major role in national food and nutritional security (Maina and Chui, 1999). Furthermore, the crop is an important food and cash crop in the medium and high rainfall areas (Kiiya et al., 2006). In high and medium rainfall areas, it is grown by about 500,000 farmers, cultivating 108,000 ha with an annual production of over 1 million tonnes in two growing seasons (MoA, 2005). It is also grown together with beans in the drier parts of the country during the short rains season when maize will normally do poorly (Kiiya et al., 2006). Potatoes are often eaten with beans in most poor rural households during the 'hunger period' just before the maize crop matures in the long rains sea-

*Corresponding author. E-mail: jayney480@yahoo.com.

son. They are also included in the basic diet of maize and beans as a vegetable to add flavor and variety (Shah and Frohberg, 1980).

In Kenya, potatoes are mainly cultivated in the high altitude areas (1500-3000 m above sea level) where Kenya's main staple food has no comparative advantage. These areas include slopes around Mt. Kenya, such as Meru, Embu, and Kirinyaga; parts of Laikipia and on both sides of the Nyandarua (Aberdare) range that coves parts of Nyeri, Muranga, Kiambu and Nyandarua Districts. They are also grown in the highlands on Mau Escarpment (Mau Narok and Molo), Tinderet, Nandi Escarpment and Cherangani hills. Small acreages are also cultivated in Kericho and Kisii areas and isolated patches near the Coast in the Taita hills (Kirumba et al., 2004).

Highland farmers can complete three planting seasons with potatoes (each season being 3-4 long) unlike maize, which takes up to 10 months in these areas to mature. Potato thus becomes a steadier source of income and is planted both as a cash crop and staple food by farmers (Wambugu and Muriithi, 1984). Above 2100 m above sea level, potatoes grow faster than maize and the total energy and protein production per hectare per day is higher for potatoes. Over 70% of potato production is in this zone (Wambugu and Muriithi, 1984). At these altitudes the net revenue per hectare for potatoes is more than double than of maize (Durr and Lorenzl, 1980). Thus for land restricted Kenyans, potatoes are a logical and important crop to promote in the highlands areas.

While average potato yields in North America and Western Europe often reach 40 tonnes per hectare, yields in developing countries are usually below 20 tonnes per hectare. The national average potato yields for Kenya has been reported at 7.7 tons per hectare, but this figure has fluctuated considerably over recent years, from over 9.5 ton/ha to around 7.5 ton/ha (FAO, 2008). The low yields have been attributed to poor agronomic practices, low use of inputs especially fertilizers, low soil fertility, limited access to good quality seeds, diseases (especially bacterial wilt, late blight and viruses) and insect pests (MOA, 2005; Nganga et al, 2002; Maingi et al., 1992). Fertilizers and pesticides are being used at rates below economic optimum since farmers direct their resources to other high value 'important' crops such as pyrethrum, onions, tomatoes, barley, tea, coffee, maize, beans and wheat (Nganga et al., 2002).

Production constraints

Seasonality in potato production

Potato production is characterized by rapid and significant fluctuations in supply and demand. Most farmers produce potatoes twice a year due to bimodal rainfall patterns in most potato growing areas. Long rains season occurs from March/April to June/July with the short rains season occurring in October to December. Off-season potato production is limited to a few areas such as Meru-Central where there is irrigation. However, most farmers direct their irrigation water to other high value crops such as vegetables and flowers since water charges are high (Kaguongo et al., 2008). This limits profitability in potato farming as majority of farmers depend on rainfall leading to glut and lean times consecutively. Generally, June, July and August are the glut seasons with farm gate prices at Ksh 400-500 /Bag and market wholesale prices at Ksh 900-1100. December, April and May are the scarce periods with farm gate prices at Ksh 1000-2000 /bag and wholesale prices at Ksh 1600 to Ksh 2000 per bag (Kirumba et al., 2004). This means low net returns to farmers during the glut season.

Low soil fertility

The major constraint to potato production in the cool highlands of Kenya is the rapid decline in soil fertility occasioned by continuous cultivation without adequate replenishment of mined nutrients (Kiiya et al., 2006). Soil phosphorus in major potato growing parts of Kenya is as low as 2.9 ppm (modified Olsen) while total nitrogen is lower than 0.15% (Recke, 1997). The situation is exacerbated by the inherently high soil acidity with pH values of 4 to 5 being common (Recke, 1997; Kiiya et al., 2006). Due to small land sizes, farmers continuously plant crops on the same land, practicing intensive cropping systems that mainly involve double and relay cropping of different crops without a fallow period (Kaguongo et al, 2008). Fertilizer is mostly applied below the recommended rate of (90 kgN/ha + 230 P_2O_5/ha) (Kaguongo et al., 2008). Additionally, most farmers intercrop potatoes with either beans or maize often with no additional fertilizers. Furthermore, fertilizer recommendations do not cater for potassium yet some studies have indicated response of potatoes to potassium addition on some highland parts of the country (Recke et al., 1997). The often applied Diammonium phosphate (DAP 18:46) (Kaguongo et al., 2008; Nganga et al., 2008) has been in use for a long period of time, yet it has been shown that continuous application of this fertilizer leads to increasing soil acidity (Halliday et al., 1992; Kamoni, 2009). This acidity problem is compounded by the fact that the soils in these highlands are derived from acidic volcanic rocks and have been highly leached by high rainfall (Kabira et al., 2006). Most of the potato growing areas in Kenya have a soil pH of less than 5.5 (Recke et al., 1997; Kiiya et al., 2006). A pH of less than 5.5 severely limits availability of potassium, nitrogen, phosphorus, sulphur, calcium and magnesium, while availing excessive levels of Aluminum, manganese, Boron, Iron copper and Zinc (Ochapa, 1983). It is possible that this problem of low soil pH has led to nutrient imbalance hence reducing ware potato yields even further. Thus soil analysis is critical in most

potato producing areas before even contemplating further release of new varieties. Table 1 in the appendix gives an overview of fertilizer application by small scale potato farmers in Kenya

Table 1. Fertilizer application details by small scale farmers in Kenya

Percentage of farmers using chemical fertilizers	89
Fertilizer users applying:	
DAP	96
CAN	8
NPK	1
Amount of fertilizer applied (kg/ha)(DAP)	267
Percentage of farmers using manure	49
Average manure used (kg/ha)	2535

Source: Kaguongo et al., 2008.

Table 2. Frequency of seed sources for potato varieties grown by small-scale farmers in Kenya

Source	Own	Neighbor	Market
Varieties			
All	58	36	2
Nyayo	70	27	2
Tigoni	57	39	1
Ngure	34	51	3
Tigoni Red	18	69	5
Kimande	84	16	0
Asante	40	46	3
Desiree	69	31	0
Kerr's Pink	37	48	0
Meru Mugaruro	64	33	0
Komesha	69	25	0

Source: Kaguongo et al., 2008

Lack of certified seeds

There is inadequate supply of certified seeds to the extent that farmers almost solely depend on informal seed sources (farm-saved, local markets or neighbors). Self-supply is the major source of seed for most farmers (Kaguongo et al., 2008). Kenya Agricultural Research Institute (KARI), Tigoni produces basic seed for multiplication in high altitude farms. Being the sole source of clean basic seed in Kenya, its physical and human capacity is limited as it struggles with the double mandate of research and commercial basic seed production (Kaguongo et al., 2008). It is handicapped by institutional arrangement in which there are very little incentives for increased productivity and efficiency (Kaguongo et al., 2008). It produces between 25 and 55 tonnes of basic seeds per year (KARI, 2007). Only about 1% of potato farmers can access quality planting material since the collapse of the national seed distribution network in the 1990s (Ayieko and Tschirly, 2006).The quantities of certified seed potato produced are not only inadequate (Lung'aho et al., 1997) but also highly priced with the implication that majority of farmers resort to using use seed of doubtful quality from various sources (Kinyae et al., 1997; Mureithi, 2000). This exacerbates the spread of seed-borne diseases especially bacterial wilt.

From one season to the next, farmers select seed at harvest from their own farm but periodically go outside their farms to bring in "new" or "fresh" seed (seed renewal) from the sources shown and at the indicated frequencies (Table 2). Farmers renew seed for various reasons including acquiring a new variety, seed degeneration, disease and weather calamities (floods, drought etc) (Ng'ang'a et al., 2003).

The concept of certified seed is not clear to most farmers and most people believe that when productivity of a variety decreases then the variety is "used to" or "too familiar" to the soil. They then usually buy seed from another area, exchange their seed with their neighbors or try and change the location of their potato plot (Ng'ang'a et al., 2003). The farmers frequently plant the smallest tubers (chatts) as seeds and either eat or sell the bigger ones since the commercial middlemen select against the small, diseased and damaged tubers (Barton et al., 1997). These small seed tubers produce single stems, produce few tubers and are susceptible to diseases such as bacterial wilt and other environmental stresses (Lung'aho pers. Comm.). An economic analysis comparing use of farmers' seeds with use of certified seeds showed that, under the agronomic practices currently practiced by farmers and current prices of the certified seed and ware potatoes, farmers will incur loss if they use certified seeds as opposed to their own seeds (Nganga et al., 2003). Interventions to either reduce the cost of certified seed or improve ware potato production and hence returns to farmers are thus critical if use of certified seed is to be enhanced.

Bacterial wilt

In all potato growing districts, bacterial wilt (caused by *Ralstonia solanacearum)* is regarded as an important disease contributing to yield reduction (Kaguongo et al., 2008; Mureithi, 2000; Otipa et al., 2003). It is considered more problematic than late blight since it has no known chemical control procedures and many farmers do not know how to control it. While it could be controlled through crop rotation, this is not feasible due to small farm sizes which hinder effective rotation programmes. The disease has been reported to cause losses ranging between 30-70% at altitudes ranging 1800-2800 m (Otipa et al., 2003). Increased bacterial wilt occurrences can be explained by the lack of appropriate management practices as research on this subject has been at very low

scale (Lemaga, 1997). Seed tubers with symptomatic or latent infection are a potent source of innoculum of *R. solanacearum* leading to disease outbreaks and pathogen spread from place to place and from season to season (Nyangeri et al., 1984; Kinyua et al., 1998). Seed is an important factor in wilt management and in order to develop meaningful control practices, it is important that the status of bacterial wilt in seed tubers available to farmers from various sources is known.

High cost of inputs

High cost of inputs especially seeds; fungicides and fertilizers greatly limit the production of ware potatoes in Kenya (Kaguongo et al., 2008). This leads to under application of fungicides and fertilizers and coupled with poor quality seeds, the net returns to the farmer are minimal. Seed prices vary with varieties and from one area to another, with prices of most improved varieties having higher mean prices compared to the local varieties (Kaguongo et al., 2008). Seed costs contribute a significant 42% of the total production costs (Kirumba et al., 2004). High cost of inputs is to a large extent a reflection of poor producer prices (Nganga et al., 2003). Low producer prices are mainly due to seasonality of production coupled by lack of proper on-farm storage methods and monopolization of market by the middlemen who exploit the small scale producers. The immediate cash needs and lack of appropriate preservation techniques force farmers to sell their produce from the field at a price dictated by middlemen.

Marketing constraints

Poor marketing channels

Most farmers do not store potatoes but sell directly from the field leading to glut periods, depressed prices and correspondingly low net returns to farmers (Kaguongo et al., 2008). Seasonality in production and supply makes rain dependent producers prone to exploitation by traders and brokers. This results in widely fluctuating farm gate and market potato prices, sometimes with the minimum and maximum prices varying by more than 70% (Kaguongo et al., 2008). Generally, June, July and August are the glut seasons with farm gate prices at Ksh 400-500 /Bag and market wholesale prices at Ksh 900-1100. December, April and May are the scarce periods with farm gate prices at Ksh 1000-2000 /bag and wholesale prices at Ksh 1600 to Ksh 2000 per bag (Kirumba et al., 2004). On-farm storage of potatoes can help in price leveling assuming that lack of appropriate storage rather than immediate cash needs is the main reason for selling potatoes straight from the field.

Currently the potatoes are marketed through a vertical chain characterized by many handlers and high transaction costs. There is multiple handling of up to 5 different handlers of potatoes from the farm to the final consumers thereby affecting prices and quality. There is domination of brokers along the marketing channel (Kirumba et al., 2004). The volumes handled by individual farm units do not command economical volumes for competitive marketing. The price differentials between producer and consumer prices are very huge of up to 300% and in distant towns like Mombassa up to 1000%. The margins between the wholesale and retail prices in the urban areas are very huge (up to 40%) and are mainly caused by inefficient distribution systems (Kirumba et al., 2004).

Over 90% of farmers sell their potatoes through middlemen and most farmers are exploited (Kaguongo et al., 2008). There are also high incidences of supplying low quality produce due to farmers' cash flow problems which affect their acquisition and use of optimal farm inputs. Most potato growing areas are characterized by poor infrastructure. Transporting potatoes to markets accounts for approximately 23% of the wholesale price (Kirumba et al., 2004). The flow of market information in markets themselves and to farmers is erratic, unreliable and exploittative with market level having clandestine cartel-like operators both at the market place and at farm level.

Farmers usually pack ware potatoes in extended bags and as such they are sometimes unable to know the actual amount they pack in the bag since they sell in bags and not weights (Kaguongo et al., 2008). Instead of using a standard bag of 100-110 kg per bag, some farmers use extended bags that contain between 120 and 200 kg of potatoes depending on their target market (Kaguongo et al., 2008). Official standardization of potato package into 110kg bag was done only towards the end of 2008 and even then its enforcement is doubtful (MOA, 2008).

- Potatoes are stacked above the brim to form a mound which is led together using net of strings or by another half bag.

Conclusions

This review reveals that low soil fertility, lack of quality seeds and attacks by pests and diseases are the main factors that limit Irish potato production in Kenya. The study also reveals that access to certified seed is limited by lack of appropriate supply channels and high per unit cost. This has led to self supply and neighbor supply being the main sources of potato seed in the country. In addition, high costs of inputs such as fertilizers and fungicides have led to their suboptimal application resulting in low yields.

Production of potatoes being largely rain-fed; there are seasonal fluctuations in supply of potatoes. This, coupled with limited on-farm storage facilities, results in low prices during the peak production periods and hence low returns to farmers. Furthermore, marketing channels of the produce are controlled by cartels and brokers leaving farmers with minimal opportunity to negotiate for prices. Poor road infrastructure and disregard to standards such as weight

per bag and produce quality tend to worsen the situation.

There is urgent need for the government to enforce the existing regulatory measures such as weight standards to save the farmers from exploitation by the market cartels. Improvement of the road network will also assist to cut down the transport costs. In addition, the government should assist farmers to organize themselves into cooperatives that will assist in selling their produce. This too will protect farmers from being exploited by brokers.

Lastly, there is need to build the capacity of farmers to produce certified potato seed if potato production is to be improved. Such capacity includes training and financially empowering farmers through credit facilities.

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