Potato Research

Emerging Markets for Potatoes and Potato Products in East and Central Africa 1961-2010

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Emerging Markets for Potatoes and Potato Products in East and Central Africa 1961-2010

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Abstract As diets continue to diversify across the globe, food systems increasingly try to respond to product requirements in light of growing urbanization, population expansion, shifts in incomes and changing tastes and preferences. In that context, potato production expanded more rapidly in Africa than in any other region of the world in recent years according to FAO statistics. This paper analyzes the evolution of potato production, utilization, and trade in Sub-Saharan Africa over nearly the last half century. After an analysis of FAO annual secondary data on regional trends in production and use complemented by a selective review of previous publications, the paper identifies some key issues for future research as well as some opportunities for industry.

Keywords: Technology; production; trade; consumption; processing; private sector

Introduction

Of all the developing country regions, the evolution of potato production in Sub-Saharan Africa (SSA) has been perhaps the most enigmatic. With a long history in the food systems across the region (Dürr and Lorenzl 1980; Scott 1988; Andersson 1996; FAO 2009), potatoes have repeatedly been singled out as a crop with unrealized potential (Van der Zaag et al. 1984; Haverkort 1986; Scott 1992; Low et al. 2007; Hirpa et al. 2010; Gildemacher et al. 2009a). Yet, potato producers and consumers have recurrently suffered from outbreaks of major diseases, civil strife, the shortage of marketing infrastructure, and institutional instability among other factors (Dürr, 1983; Scott 1988, 2002; Walker et al. 1999; Ferris et al. 2001; Goossens, 2002; Gildemacher et al. 2009b). Notwithstanding, recent trends in output, area, and yields for potatoes in Africa (Walker et al. 2011) have surpassed previous expectations (Scott et al. 2000) prompting renewed interest in the crop as a means to help meet mushrooming food requirements and contribute to efforts to enhance food security and reduce the incidence of poverty in the countryside (Thiele et al. 2010). Emerging markets for different processed potato products have also captured growing attention (Obado 2009; Tesfaye et al. 2010; Emana and Nigussie 2011) given accelerating urbanization to go along with rapid population growth. The recent run-up in international cereal prices has interjected an added sense of urgency and opportunity to the topic. Some observers have identified potato production "...in developing countries, especially those situated in Sub-Saharan Africa, as the main engines of growth..." for global output of this commodity in the years ahead (Prakash 2010).

A variety of different publications have focused on trends in potato production and use in SSA over the last five decades. Some of these documents have simply reported trends (Horton 1978, 1988; CIP 1999, 2010). Others have examined these trends as part of a broader look at the evolution of the food system for potatoes in the region (Scott 1992) or in developing countries more generally (Van der Zaag and Horton 1983; Horton et

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al. 1984; Horton 1987; Scott and Suarez 1992; Walker et al. 1999; Guenthner 2001). Others have included projections for future production, area and yields with different target years (Anonymous 1995; Scott et al. 2000). All these previous publications have been handicapped by their shorter time horizons. Few have considered potatoes in relation to the production or consumption of other food crops grown in the region.

Within SSA, East and Central Africa (ECA) currently accounts for over 45% of potato production and 52% of area harvested. Furthermore, ECA has seen some major changes in production patterns and marketing trends in recent decades. With that has come a series of different publications on one or other aspect of production, trade or consumption of this tuber. This paper seeks to consolidate the historical data and related studies on potatoes and thereby benchmark future prospects not only in terms of the trends but also the associated rates of change in the growth rates themselves. In so doing, the paper also tries to analyze potatoes in the broader context of related information on other food crops. One key theme is the extent to which the long-term evolution of these trends foreshadows the most likely future scenario for potato production and use in ECA in the decades ahead and the associated opportunities for industry.

Materials and Methods

The analysis of growth rates in potato production and use in ECA over nearly the last half century presented here utilized a three-step approach as previously presented in Scott (2011) for Latin America and then further developed in Scott and Suarez (2011, 2012a, 2012b) for Asia. As a first step, FAO (Food and Agricultural Organization of the United Nations) times-series data were used to estimate average annual growth rates on a point-to-point basis beginning with production, area and yields for potatoes and then including other crops. The use of FAO data facilitated international comparisons across countries for key potato parameters and an analysis of the crop's performance versus that of other food commodities. To that end, annual averages calculated for key production indicators for potatoes for the beginning (1961-63) and end (2008-10) of the period under consideration anchored the analysis and estimates of growth rates over the entire 49-year period. Subsequently, comparable averages for 1984-86, or roughly the mid-point in the overall time-series, were used as reference points to calculate growth rates over the first (vs. 1961-63) and second (vs. 2008-10) halves of the times-series to determine if growth rates were slowing down or speeding up. A review of similar growth rates calculated for the other major food crops in ECA helped to better contextualize regional developments in the potato sector over the last five decades.

A second step in this study involved tracking the rate of change in average compound growth rates (ACGRs) for potato production, area harvested and yields on a more continuous basis during the last five decades. In other words, as referencing a particular set of years (e.g., 1984-86) or a given sub-set of time periods is arbitrary, this study also estimated, then analysed the evolution of the growth rates themselves. Hence, ACGRs for potato production and area were calculated utilizing all the data for every ten-year period beginning with 1961-1971. In other words, growth rates were calculated on a moving ten-year basis, i.e. 1961-1971, 1962-72, then on up to 2000-10. These growth rates were then plotted to observe the changes in their trajectory over the last five decades and then examined to compare over time the shifting relative importance of growth rates for area versus those for yields in relation to those for production.

As a third step, the estimated growth rates were also compared with earlier studies for clarifying the factors behind these tendencies and analysing their relative importance. The associated "wall-to-wall" field work (Scott 1995) involved ferreting out, and then analyzing not just previously published documents but also the so-called "gray" or unpublished literature that examined some aspect of potato production, marketing and utilization in one or more ECA countries in recent years. In that regard, this study does not pretend to provide an exhaustive treatment of all the topics considered or the results reported on in this growing body of previous research. Instead, it attempts to synthesize the major findings of these earlier studies as a means of helping to explain the trends that have been quantified or qualify the growth rates presented. The combined set of growth rates, data analysis, and synthesis of the related literature provide an empirical basis on which to evaluate previous projections and alternative future scenarios for potatoes in ECA in the decades ahead and emerging opportunities for industry. In so doing, the paper also draws attention to the more readily apparent inconsistencies and/or gaps in the data—a point of particular relevance in ECA—both as a word of caution relating to their interpretation and as one basis for highlighting areas for possible future research.

Results

Potato production in ECA averaged 4.3 million metric tonnes (Mg) in 2008-10 or over six times the 679,000 Mg harvested in 1961-63, nearly half a century earlier (Table 1). The increase in potato output in ECA resulted from annual growth rates for potato production that averaged 4.6%/yr or higher for nearly the last 50 years. However, this overall upward trend masks the quasi-cyclical evolution of growth rates over the 49-year period as a succession of ever faster increases were followed by equally rapid slowdowns, occasional collapses, and then renewed expansion (Fig 1). Over the last two decades, growth rates have become much more volatile. In particular, while the growth rate for production actually accelerated in the latter half of the 49-year period, the most recent trend displays a sharp downward tendency. The moving 10-year average fell from 8.3%yr during 1995-2005 to 2.1%/yr for 2000-10 (Table 2).

Area harvested in potatoes in ECA averaged 621,000 ha in 2008-10 as increases in area were largely responsible for the growth in potato production over the last five decades (Table 1). Furthermore, ACGRs for area harvested like production followed a quasi-cyclical pattern (Fig 2). They turned downward in the 1980s through the early 1990s when many countries (e.g., Rwanda, Uganda) were wracked by violence. Next they turned sharply upward from the early 1990s to mid-2000s in post-war recovery when output levels were still fairly low, only to fall back again since then as rapid growth rates became harder to sustain at much higher levels of area harvested (Table 2).

Yields for potatoes in ECA remain below the continental average of 12 Mg/ha—itself the lowest of all developing country regions (Scott 2011; Scott and Suarez 2012a). In that regard, several countries in ECA have yields among the lowest in all of SSA. With Rwanda as the exception, growth rates for average yields over the last 25 years were negative in three of ECA´s seven largest potato-producing countries (Table 1; Fig 3). It is also noteworthy that the growth rates for yields exhibit similar volatility as those for production suggesting while growth in area harvested has expanded at a much more rapid pace, yields have also had an important influence on production. Nevertheless, unlike production or area, the growth rates for yields followed neither an exponential nor linear trend (Fig 1-3). Furthermore, the empirical evidence on changes in potato productivity over time is comparatively thin, sporadic and often contradictory.

One explanation suggests as potato cultivation spread into new and/or less favourable growing areas (e.g. Uganda), it simply became harder to sustain earlier growth rates in productivity (Hakiza et al. 2000). As a corollary, at least some of these farmers that took on potato cultivation to boost household food supplies and/or supplement cash incomes may simply have been less familiar with the crop and its agronomic requirements. As a variation on that theme, the expansion in area and its effect on yields and on returns to potato cultivation (e.g. certain regions in Ethiopia) appears to have been driven in some cases by higher prices obtained from off-season production and harvest, i.e. growers seeking to optimize returns to potato production, not necessarily yields (Emana and Niguisse 2011). In others, such as the Southern Highlands of Tanzania, important inputs have been in short supply due to geographic isolation thereby handicapping growers´ efforts to optimize yields (Mpogole and Kadigi 2012). Soil degradation—an increasing problem in the highlands of ECA (see, e.g. Gildemacher et al. 2009a; Ngeno et al. 2011) and the onslaught of less favourable weather patterns and the advent of climate change (Hijmans 2003), have also undermined growers' efforts to improved productivity more generally. Alternatively, scattered facts suggest in certain cases the estimates of potato yields on which these growth rates are based may simply be too low. For example, Ferris et al. (2001) cite unpublished yield estimates for Uganda in 2000 (18 Mg/ha) more than double those reported by FAO (7 Mg/ha). More recent studies (Gildemacher et al. 2009a; Hirpa et al. 2010; Mpogole and Kadigi 2012) report similar underestimates in some cases, but overestimates in others. Finally, the sheer complexity of the cropping systems for potatoes in ECA with the widespread presence of such practices as intercropping, multiple harvests, relay cropping combined typically with the geographic isolation of the growing areas and weak organizational capacity for monitoring such cultivation patterns suggest caution in any attempt at a more definitive assessment of the trends in potato yields.

Concentration of production

As growth in potato output in ECA took off during the last two decades, it nonetheless remains fairly skewed. Four of ECA´s 17 countries account for nearly 80% of output. Conversely, four countries in ECA produce less than 10,000 Mg/yr while a further six report producing no potatoes (Table 3).

Only four of ECA´s major potato producers accounted for 82% of the increase in output for the entire two sub-regions between 1961-63 and 2008-10. Three countries: Rwanda, Tanzania and Uganda accounted for 65% of the total increase in area harvested. However, according to some observers, the contribution of some countries (e.g. Ethiopia) to the growth in production and area may be underestimated (Labarta 2012) while that of others (e.g. Rwanda) perhaps overestimated (Goossens 2002). Similar patterns of uneven growth have been observed in other developing country regions (Scott 2011; Scott and Suarez 2012a). Nevertheless, as pointed out above and discussed in greater detail below, the different data sets on potatoes in ECA present a series of anomalies such that what seems certain is that potato production has trended upward, but by precisely how much is considerably less clear.

Potatoes versus other major food crops

Growth rates for potato production and area harvested have been faster than those for the five major food crops in SSA (Table 4). However, the level of total output for potatoes remains but a fraction of that for the most important food crops grown in the region. Thus, for SSA as a whole potato ranks as the least important of the 11 major food crops in terms of total production—the same as 20 years previously (Scott 1992)—in a region where cassava, maize, and plantains dominate food production and consumption.

Notwithstanding, the overall pattern of food production appears to be gradually changing. Evidence of that trend in the case of potatoes is given the faster growth rates the crop´s relative importance in particular sub-regions shifts noticeably. Potatoes move up as high as 5th in terms of total production in Central Africa, 7th in East Africa.

Discussion

Within ECA, growth rates in potato production and use have heavily influenced by the evolution of output and area harvested in Ethiopia, Kenya, Tanzania, Uganda and Rwanda as the major potato-producing countries. It is noteworthy that four of those countries are in East Africa (Table 1).

East Africa

In Kenya (pop. 39 million, World Bank 2011), potato is among the four most important food crops after maize, plantains, and wheat according to FAOSTAT (accessed June 2012). Nevertheless, Kasina and Ndiritu (2010) refer to one set of national statistics that place the tuber second only to maize in terms of the volume of total output. At the macro level, potatoes have helped dampen Kenya's dependence on maize imports (De Groote et al. 2012) which averaged 186,000 Mg during 2000-08 before ballooning to 1.5 million Mg in 2009 (FAOSTAT accessed July 2012). At the farm level, the crop has long played an important role in food security to offset seasonal shortages of maize and other staples (Dürr and Lorenzl 1980; Muthoni and Nyamongo 2009). Potatoes also serve as a source of cash income for small farmers (<1 ha) that make up the vast majority of a reported 500,000 (Crissmann et al. 1993; Muthoni and Nyamongo 2009) to 800,000 growers (dTS 2012). The share of the potato harvest sold can vary from over 75% (n=96) in the prime, potato-producing districts (Gildemacher et al. 2009a) to 25-40% elsewhere (https://research.cip.cgiar.org/confluence/display/wpa/Kenya accessed August 2012). Output remains concentrated as well. Roughly half a dozen districts—most notably Meru Central and Nyandarua North--account for well over 50% of total area harvested nationwide.

According to FAO data, since 1980 potato output in Kenya has experienced a series of busts, booms and busts with production more volatile than in any other country in ECA. After rising fairly steadily through the 1960s and 1970s, output fell by half in 1980, then again by half in 1984, then by 60% in 1987. The first two drops were yield-driven suggesting adverse weather. The third was largely due to a nearly 50% reduction in area perhaps tied at least in part to the collapse in the certified seed program two years earlier (Crissman et al. 1993). Production eventually reached an apex at over 1.2 million Mg in 2003 before then reportedly sliding down and collapsing to 400,000 Mg in 2009--driven entirely by a reported fall in average yields from 9.7 to 3.0 Mg/ha (FAOSTAT accessed June 2012). The evidence corroborating this recent implosion is mixed.

The run-up, then ballooning of maize imports may well reflect in part a growing shortfall, then sharp drop-off in potato production that was aggravated further by a severe drought in 2009 (http://news.bbc.co.uk/2/hi/8211753.stm accessed August 2012). The need for additional maize imports would also be consistent with the growing demand for potatoes in urban markets where nearly a quarter of the population live and the need to provide a substitute to offset reduced potato shipments to urban areas following a drop off in production. dTS (2012) also notes that the public-sector led certified seed program collapsed in the mid-1980s due to political interventions; hence, no new varieties were released between 1982 and 1997. But they also point out that by 2005 the Ministry of Agriculture-GTZ Private Sector Development of Agriculture (PSDA) project "… was one of the first to support the training of farmers and extension staff on clean and certified seed production, positive seed selection, and food potato production; more than 10,000 farmers and 250 extension workers were trained" (Ibid.).

Alternatively, a number of recent papers (Kibaara et al. 2008; Gildemacher et al. 2009a; Muthoni and Nyamongo 2009; Obare et al. 2010; Wachira et al. 2010; CIP 2011; Muthoni et al. 2011) make little or no mention of this major production implosion. Some observers briefly acknowledge the "decline" in potato production while others note that output stands at one million Mg. dTS (2012) refers to 2.5 million Mg/yr as annual average production of potatoes (perhaps referring to potatoes and sweetpotatoes).

As for the supposed decline in productivity, Obare et al. (2010) refer to farm survey results (n=127) with average yields at over 10 Mg/ha; Gildemacher et al. (2009a) report a median yield (n=249) of 7.7 Mg/ha and an average yield of 9.1 Mg/ha. Both studies also note that declining soil fertility, widespread incidence of potato viruses, the limited use of good quality planting material—in part due to its relatively high price—and chemical fertilizers, and miniscule average farmland in potatoes (0.34 ha) as among the major constraints to improved productivity. Hence, the continued expansion in area harvested meant some potato cultivation extended into less-favoured production zones (Muthoni and Nyamongo 2009) that no doubt had some impact on average yields as had declining soil fertility (Gildemacher et al. 2009a; Ngeno et al. 2011). The more momentary political turmoil in 2007-08 followed by the drought in 2009 also hurt productivity, but by how much is less clear. Conversely, the estimate of annual total potato output is based on the number of bags harvested assuming that they weigh only 110 kg. A more realistic weight of 150 kg/bag (Wang´ombe 2008) would translate into 40% more potatoes.

Marketing of fresh potatoes has traditionally dominated the urban vegetable trade in Kenya´s major cities. Tschirley and Ayreko (2008) estimated 50% of the total fresh produce items entering Nairobi´s wholesale markets (around 348 Mg/day) were potatoes in 2004-05. These potato shipments (127,000 Mg on an annualized basis) represented around 28% of the total value of fresh produce commercialized daily. In recent years such sales have increasingly been channeled toward the fast-growing potato processing industry (Lutaladio et al. 1995). Kirumba et al. (2004) conducted their own market survey in 2004 and reported shipments on the order of 190,000 Mg/yr. With a population of four million (http://www.mapsofworld.com/cities/kenya/nairobi/demography.html accessed August 2012) in greater Nairobi at that time, the 190,000 Mg puts per capita consumption at about 48 kg/yr or roughly equivalent to the figure estimated by Dürr and Lorenzl (1980) back in the late 1970s and those reported more recently based on a household consumption survey (n= 821) carried out in 2009 (Kamau et al. 2011). Kirumba et al. (2004) also estimated that hotels and restaurants use 160,000 Mg/yr for preparing potato chips, although that figure seems high as a share of total consumption and unlikely to represent an additional in-take beyond those based on shipments into the capital. Nevertheless, such volumes would appear to help explain why in spite of the multiple production constraints plus farmers´ reports of receiving low prices for their produce and the lack of traders for potatoes (Kaguongo et al. 2008), the production of potatoes remain very profitable (Labarta and Mulwa 2011; Kaguongo et al. 2008). In effect, this high profitability would appear to respond to the increasing popularity of French fries and potato crisps to go along with the gradual growing relative importance of potatoes in urban diets in general and therefore the growing importance of potato supplies for satisfying urban demand as a result (Walingo et al. 2004; Abong et al. 2010; Ooko and Kabira 2011).

Given these unfolding developments, the government of Kenya has encouraged greater potato production and marketing, for example, by allowing private sector production of mini-tubers and certified seed since 2009 heretofore largely the monopoly of the public sector (CIP 2011; dTS 2012). This policy has resulted in the increase of quality seed potato availability from less than 0.5% of annual seed potato requirements in Kenya to around 5% (CIP 2011; Labarta and Mulwa 2011; dTS 2012). Use of quality seed potato is expected to at least double the potato yields under current small-farmer conditions (Wachira et al. 2010) and consolidate the role of large-scale producers as increasingly responsible for supplying potatoes to urban markets (Lutaladio et al. 1995). The government has also tried to facilitate the trade of ware potatoes in urban markets by standardizing the use of 110 kg bags for all potato sales from farmers through to wholesalers (Tschirley and Ayreko 2008; FAO 2009). Notwithstanding, concerns persist regarding the enforcement of such regulations given the propensity of traders to take advantage of growers by paying per bag based on the new standard weight while using traditional bags that full weigh 150 kg (Wang'ombe 2008; Kasina and Ndiritu 2010).

Several observers have implied that Ethiopia (pop. 81 million, World Bank 2011) has perhaps the greatest potential for expansion for potato production in all of SSA. The country has almost 7 million ha of highlands suitable for potato cultivation and a reported one million growers (Hirpa et al. 2010). In that context, several studies have documented the continued growth of potato production, from 360,000 to 587,000 Mg/yr between 1996 and 2010 according to FAO data, while also recognizing the stagnation of potato yields (Agiro 2011; CIP 2012; Labarta 2012; Table 1). A shortage of good quality seed, low input use and the prevalence of various pest and diseases have prevented growers from achieving full yield potential (Kassa and Beyene 2001; Gildemacher et al. 2009a, 2009b; Hirpa et al. 2010). As there is no public sector seed potato program, recently a Dutch firm set up operations in Ethiopia to produce high quality planting material albeit on a limited scale (Hirpa et al. 2010).

In that context, Agiro (2011) contends that most of the potato production in Ethiopia takes place during the Mehr season. FAO statistics appear to base their estimates of potato production and area on data for that season as they typically are reported that way by national entities (CSA 2009; FAOSTAT accessed June 2012). But Gildemacher et al. (2009a)´s recent survey of potato farmers (n=336) found that the importance of different growing seasons for potatoes varies from zone to zone within Ethiopia. Emana and Nigussie (2011) made the same observation as part of their study. Moreover in 2002, while FAOSTAT (accessed June 2012) reported area at 36,736 ha and total production to be 385,258 Mg, agricultural census figures for both seasons indicated 1.5 million grower harvested 162,854 ha of potatoes –versus 8.2 million ha of cereals on average for 2004/05-2007/08 (Taffesse et al. 2011) –with output at 937,351 Mg (CSA 2002), thereby making any assessment of trends for those parameters that much more problematic for several reasons. Past studies are vague on this topic (Börgel et al. 1980). There appear to be no published statistics to verify or refute this pattern over a number of years. Moreover, the recent literature either overlooks the issue by only reporting production for the Mehr season (Agiro 2011) or presenting results only for certain regions within the country where the importance of the Belg season varies considerably (Gildemacher et al. 2009a; Emana and Nigussie 2011) without giving a breakdown of total production nationwide attributable to all three seasons (Hirpa et al. 2010). Hence, this is a topic that merits clarification in future research. Notwithstanding, the Ethiopian government has tried to implement a development policy since 2006 that charges agricultural cooperatives with a key role in the production and commercialization of agricultural products: supplying 90% of all the agricultural inputs and marketing around 60% of agricultural outputs (Agiro 2011).

In the case of potatoes, only seed potato cooperatives have benefited their members while ware potato cooperatives have not played a major role and were not able to improve market access and reduce transaction costs for potato producers (Abebe et al. 2010). Part of the limitations faced by ware potato cooperatives specifically have been conditioned by the overall constraints faced by the potato marketing system in Ethiopia in general. According to recent farm surveys, the vast majority of potato production is produced on a very small scale (<0.75 ha) most of which appears to be sold for cash (Gildemacher et al. 2009a; Hirpa et al. 2010), although the same surveys indicate growers also eat potatoes (Gildemacher et al. 2009a; Obado 2009; Hirpa et al. 2010) and Agiro (2011) cites census data that show only 15% of the (Mehr season) potato harvest is sold. Nevertheless, the selling off of surplus tubers has reportedly been handicapped by the lack of markets—only 19% of Ethiopia´s population is urban (World Bank 2011), low prices, large numbers of middlemen, high transaction costs and poor product handling (Emana and Nigussie 2011)—factors that also help explain the difference between current production and the potato's output potential (Gildemacher et al. 2009a).

Potatoes are often referred to as a cash crop in Tanzania where maize is the staple (AATF 2010). Although some strictly commercial growers exist, the vast majority of potato farmers cultivate the crop on small, fragmented plots, under rain-fed conditions utilizing multiple varieties both for sale and as a form of on-farm food security (Mpogole and Kadigi 2012). While potato may cover on average as much as 45% the total area cultivated in different crops according to one recent survey, it amounts to less than a hectare of land (Namwata et al. 2010).

According to FAOSTAT, Tanzania produced more potatoes than any other country in East Africa in recent years. Production grew steadily from 15,000Mg in 1961 to over 200,000 in 1979, then fluctuated around that total for nearly the next twenty years falling to 165,000 Mg in 1993 and rising to 250,000 Mg in 1999. Since then output has been more volatile. As an assortment of diverse trends converged at the turn of the century, potato output nearly doubled between 2000 and 2008 (SAGCOT 2011). In the interim, production surged to over 630,000 Mg in 2002 before crashing to 140,000 Mg in 2003 as area harvested fell by 40%, then rebounded to 730,000 Mg in 2004.

The evolution of potato production and marketing in Tanzania have long been dominated by developments in the Southern Highlands where some 90% of output is harvested and consumed (Andersson 1996; Namwata et al. 2010; Mpogole and Kadigi 2012) and demand patterns in Dar es Salaam 900 km away, the country's most important urban market. The remaining roughly 10% is harvested in the northeastern part of the country— in Arusha, Kilimanjaro, Manyara regions (SAGCOT 2011). Part of that output is exported informally (i.e. does not appear in official trade statistics) to Nairobi or Mombasa (Tesfaye et al. 2010) while Kenyan growers ship part of their harvest to Mwanza in far western Tanzania largely as a reflection of roads and truck transport that connect the respective growing areas with urban consumption centres (Ferris et al. 2001). Production has also expanded into the central part of the country (Morogoro region) given its closer proximity to the capital and other, smaller cities that have emerged as secondary markets in recent years—over 25% of Tanzania´s population of 42 million is urban (World Bank 2011). In effect, growing urbanization both in Tanzania and neighbouring Kenya have generated strong off-farm demand to go with rising rural food requirements resulting from continued population growth (2.9%/yr, Ibid.) and declining farm size in the countryside.

More recent expansion has slowed as productivity continues to be constrained by the limited use of improved quality planting material, chemical fertilizers and pesticides. To that end, one recent public-private partnership has secured a long-term lease on 2,300 ha in the Southern Highlands to produce seed potatoes for small growers. Moreover, the operation has recently released four new potato varieties—reportedly the first such new varieties to be released in Tanzania in 30 years (http://www.lhgp.com/120709-Voxtra_MFL_press %20release_final.pdf accessed August 2012).

Potato production in Uganda (pop. 32 million, World Bank 2011) expanded fairly steadily from 100,000 Mg in 1961 to 345,000 Mg in 1976 according to FAO data, before being interrupted by two civil wars during 1979-86 (Ferris et al. 2001). Output fell to 98,000Mg in 1986. Since then, production first recovered, then rose rapidly to some 690,000 Mg by 2010. Supply-side factors contributing to this expansion include a combination of renewed security in the countryside, political stability, and the introduction of several new varieties (Ibid.). Still, even in the Western region of the country that accounts for over 75% of national production, recent agricultural census data show that less than 5% of the agricultural households cultivate potatoes (UBOS 2007). As the average potato producer cultivates around a hectare total of the crop on an annual basis, typically over two or more growing seasons, most of the tubers harvested are for on-farm consumption with a minor percentage serving as a source of cash.

The most recent increase in supply has been driven by continued strong population growth (3.3%, World Bank 2011) and mushrooming urbanization that together generated additional demand for food in both rural and urban (13% of total pop., Ibid.) areas. Rising incomes from rapid economic growth in recent years have provided an added boost to domestic urban demand (Haggblade and Dewina 2010) as evidenced the arrival of fast food chains such as Steer's and Nando's chicken from South Africa (http://en.wikipedia.org/wiki/Steers accessed July 2012; www.nandos.com accessed July 2012). Given these demand factors combined with the crop's relatively short vegetative cycle and high yields, potato production can be highly profitable despite the litany of production and postharvest constraints listed in technical reviews (Ferris et al. 2001; Mulema et al. 2005). These include: poor quality planting material; pest and diseases—most notably late blight and bacterial wilt; lack of an all-weather rural road network; absence of commercial storage facilities in the countryside; minimal marketing infrastructure in the cities and towns to conduct marketing activities; and the weak public support provided private marketing initiatives, e.g. information (Ferris et al. 2001; Tesfaye et al. 2010). Some potato farmers have managed to organize themselves and profitability supply up-scale, multinational urban restaurants (KIT 2006). It is less clear how broad and deep this high quality and high margin segment of the urban potato market may be versus the price differentials, if any, paid by local bars and eating establishments when compared with prevailing wholesale prices.

Central Africa

Rwanda (pop. 10 million, World Bank 2011) is the most densely populated country in SSA (Goosssens 2002). It accounts for over 90% of regional potato output in Central Africa. The crop is currently a secondary staple food after sweet potatoes, cassava, and bananas; sorghum, maize and beans also play an important part in the average diet (NISR 2010). In that context, production and area harvested witnessed a series of abrupt declines, renewed expansion followed by fall-offs, then surges over the last half century. Output fell from 96,000 Mg in 1961 to 30,000 Mg in 1964, then eventually reached 335,000 Mg in 1985 only to implode to 171,000 Mg in 1988. Strong demand for potatoes—on and off the farm—particularly in the more densely populated parts of the Volcanic region in the northwest part of the country where output is still concentrated, had spurred greater production (von Braun et al. 1991). Disease outbreaks were partly to blame for the subsequent decline in output. Moreover, the successful introduction of new production technology in the late 1970s, early 1980s (Mendoza et al. 1994) occasionally resulted in gluts as bumper crops got ahead of rapid population growth in certain parts of the country. The resulting collapse in prices played an added role in the subsequent shrinkage of area planted during the mid-1980s (Scott 1988) and then again, albeit on a smaller scale, in the very late 1990s (Goossens 2002). The steep drop in production from 445,000 Mg in 1991 to 115,000 Mg in 1994 was but a part of the collateral damage from the civil war and unrest that terrorized the country from 1992 to 1999 (Ibid.).

Latent demand in the cities and towns, favorable weather, and hunger in the countryside helped output surge from 176,000 Mg in 1999 to 957,000 Mg in 2000 as potato prices surged, markets for alternative crops collapsed, rainfall patterns were optimal and 10,000ha of the Giswhati forest were cleared and planted in potatoes (Goossens 2002; Fané et al. 2004, 2006; FAOSTAT accessed June 2012). Production fluctuated around 1-1.2 million Mg up to 2009 before jumping to 1.8 million Mg in 2010 as growing urbanization, continued population growth (3.2%/yr, World Bank 2011), and pressure on land as reflected in declining farm size made potatoes an ever more attractive crop given its relatively short vegetative cycle and high yields compared to other commodities. Potato has also received support from the central government that has placed it among the five top crops to be promoted in order to achieve impact on food security (Bizimana 2007). Notwithstanding, estimated output levels, area harvested and yields have continued to differ considerably over time depending on the source (Goossens 2002) with recent census data putting production in 2008 at 627,000 Mg (NISR 2010) versus 1.16 million Mg according to FAOSTAT (accessed June 2012). Monitoring of cultivation is complicated by the fact that most growers plant less than a hectare of potatoes in two seasons with total area cultivated less than half a hectare in the prime, potato-growing provinces of Ruhengeri and Gisenyi (Fané et al. 2004). While potatoes are also sold for cash, various studies over the years (Dürr 1983; Loveridge 1988; Scott 1988; von Braun et al. 1991; Munyemana and Von Oppen 1999) have reported estimates that these sales vary from 15 to over 50% of the annual total harvest. More recent studies indicate about 40% of output is sold although the percentage varies from region to region (Gosseens 2002).

Utilization and Trade

The overwhelming bulk (73-86%) of all the potatoes produced in SSA is for human consumption (Table 5). Most of the remainder goes for seed (11%) or so-called “other uses” (9%). No potatoes serve for industrial use (e.g., starch)—with much more abundant quantities of cassava available for such uses instead (Table 4). Only modest quantities are fed to livestock.

According to FAO data, the principal changes in potato use patterns over the last five decades in ECA involve the declining share of potatoes utilized as seed in Central Africa (Table 5). The evidence to substantiate this trend is largely conjectural. Nevertheless, as area has expanded and as this has been increasingly done by small farmers in more marginal production zones, then it might be argued that they use less seed per hectare equivalent. In these locations, seed tubers in general are expensive and hard to come by helping to drive down their use as a percentage of total available supply in the process.

Potato plays a variety of different roles in diets in ECA. In the highlands in particular, potatoes serve as a food crop for on-farm consumption—in some areas as a basic staple and others (i.e. mid-elevation zones below 1200 m) as a complement to maize or sorghum as average per capita consumption for all of ECA remains minor (≤ 12 kg/capita/yr) by comparison (Table 6). In some highland locations (e.g., the Volcanic region in Rwanda), potatoes are eaten more as a staple with consumption levels over 200 kg/capita/yr (Goossens 2002). In addition, potatoes serve a food security commodity either during the "hungry season" before the maize crop is ready for harvest or should shortfalls after harvest time generate the need for a home-grown food supplement. Potatoes eaten as a snack (chips) or cottage-industry French fries have become increasingly popular in urban areas in much of ECA (Tesfaye et al. 2010). But other than in the major cities (e.g., Dar es Salaam, Kampala, Mombasa, Nairobi), ECA has yet to see the emergence of quick service restaurant chains on a scale that has become common in Latin America (Scott 2011) or East Asia (Scott and Suarez 2012c). Instead, in Kenya and Rwanda, among other countries, small informal enterprises have captured a hefty niche in this urban market by integrating procurement, processing and retail sales direct to the public, or the processing is done "in-house" by the restaurants and hotels themselves (Kirumba et al. 2004; Tesfaye et al. 2010). At the same time, potatoes still play a very minor role in the average diet, although their relative importance varies considerably from major production zones (high), to urban areas (moderate), to rural areas where potatoes are not grown (negligible at best).

Given this situation, it is noteworthy that potatoes are one of only a few commodities that experienced an increase in per capita consumption over time and across sub-regions. The evolution of per capita in-take has closely mirrored the bust-boom changes in production adjusted for gradual shifts in utilization patterns according to final use combined with steady population growth (Table 6, Fig 5). Over the years, imports have represented a very small percentage of total available supplies (Scott 1992; Table 7).

Prospects for greater potato exports have long interested policymakers in ECA (Dürr and Lorenzl 1980; Scott 1988, 2002; Ferris et al. 2001; Goossens 2002; Emana and Niguisse 2011). In the post market-liberalization era in particular, trade in general has been seen as a driver of economic growth and development. In the specific case of potatoes, trade was often considered as a possible source of foreign exchange. In that regard, potatoes were often considered as a less attractive food commodity (e.g., versus maize) with a corollary that potato exports potentially represented a way of offsetting the cost of cereal imports to meet domestic food requirements. Alternatively, several recent studies have highlighted the interest in reducing imports of potatoes and potato products as a possible means of stimulating greater domestic production and capturing the associated value added (Tesfaye et al. 2010)

While potato output has expanded rapidly over the last five decades in ECA, average annual total trade (imports plus exports for the combined total of fresh tubers including seed, frozen French fries, and potato flour) represents just two percent of annual production (Table 1 and 7). The overwhelming bulk of registered trade of SSA origin consists of exports from Rep. of South Africa (RSA) to neighbouring countries in the form of table potatoes and seed (Anaya 2009; Table 7). RSA also exports small quantities of frozen French fries to a number of countries (Tesfaye et al. 2010). In addition, there is a considerable history of European potato producers exporting some seed and table potatoes to francophone West and Central Africa primarily, but also to East Africa's smaller, non-potato producing countries (e.g., Djibouti, Seychelles) (Gutteridge 1983; Scott 1992). That practice continues today, but the volumes are extremely small.

Various more recent reports have called attention to the informal, cross-border trade in potatoes, e.g. from Tanzania to Kenya or vice-versa (Ferris et al. 2001; Tesfaye et al. 2010), or from Rwanda to Burundi (Scott 1988; Goossens 2002), Ethiopia to Djibouti and Somalia (Börgel et al. 1980; Hirpa et al. 2010; Emana and Nigussie 2011). But the volumes involved are hard to quantify in anything more than an anecdotal way. Projected increases in exports by some countries have also failed to materialize (Goossens 2002) as domestic markets haves absorbed available surpluses. Conversely, the sparse empirical evidence suggests this trade is highly localized given the high cost of transport in relation to the low value to weight ratio for potatoes. Nevertheless, the cross border shipments can be highly dynamic in response to shifting supply and demand patterns.

Past Projections and Future Prospects

Earlier FAO-CIP short-term projections (Anonymous 1995) for average annual growth rates for potatoes for the period 1988 to 2000 were for Africa in total and not by sub-region. Be that as it may, those projections for production (3.73%) and area (2.18%) proved far too conservative for ECA during that time span. In the case of yields, the projected growth rate (1.49%) was actually well above the equivalent for ECA. In retrospect, it was hard to anticipate the end of various civil (or near) wars and the impact of peace, among other things, on potato output and productivity in a number of major potato-producing countries (e.g., Angola, Rwanda, Uganda).

Longer-term projections for production, area, and yields in SSA for the period 1993 to 2020 developed using FAO data have also proved too modest (Scott et al. 2000). Projected growth rates for production (3.01%) and area (1.25) generated estimated totals for 2020 according to the baseline scenario (Ibid.) that had already been surpassed in 2008-10 (Table 1). The only slightly more ambitious projections according to the high demand scenario (Ibid.) also proved far too conservative. What proved much more of a challenge was projecting the growth rates for yields. Both the baseline (1.25%) and high demand (1.27%) scenarios envisioned growth rates that simply haven't come close to materializing in large part for the reasons previously enumerated.

Conclusions

Potato production has expanded more rapidly in SSA than in any other part of the world over the last five decades, albeit from a very small base. In ECA, the bulk of that increase has come from an expansion of area harvested including into more marginal growing areas to meet the growing rural and in particular urban demand. Going forward, a series of observations bear mentioning.

While some potato production takes place all across ECA, the bulk of output and the increases in area over the last several decades have been concentrated in just three major potato-producing countries out of the 17 found in the two sub-regions. In many countries in ECA, potatoes have long been an important commodity for the farmers that grow, eat and sell them as well as for the research scientists dedicated to crop improvement. Policymakers and the private sector have generally speaking been less interested because potatoes are neither a major staple, nor an important source of foreign exchange. Other food commodities--most notably maize, fit the first criterion better; high-value fresh fruits and vegetables, among other crops, the second. These considerations have been important because of the investments required in infrastructure and technological innovation for potatoes to reach their potential and the absence of which has contributed to the slowdown in growth rates in productivity.

Recent field surveys have generated a very detailed mapping of the various constraints to potato production and marketing in several of these countries highlighting the linkages between the different sets of constraints i.e. how poor market integration discourages farmers from pursuing opportunities to improve productivity as well as the quality of the potatoes they harvest. Furthermore, the sheer of number of constraints: technical (new varieties, late blight, bacterial wilt), environmental (declining soil fertility, drought, deforestation), financial (shortage of credit), infrastructural (tissue culture labs, storage facilities, rural feeder roads), institutional (weak extension, market regulation) and informational (market prices) make reversing course in the sector that much more challenging. Given these findings, a more pessimistic scenario for the sector going forward need only point to the recent downward trend in area harvested and the secular decline in the growth rates for yields to suggest that should the present pattern continue the growth rate for potato production seems certain to continue to fall. Moreover, if some of the more ominous predictions of climate change prove prescient (Hijmans 2003; Ehrhart and Twena 2006), one can readily envision the pessimistic scenario becoming bleaker yet with the prospect of growth eroding into stagnation.

Alternatively, policymakers' perceptions of agriculture have begun to change of late (Binswanger-Mkhize et al. 2011). In the case of potatoes, recurrent food shortages, the rise of international commodity prices, and the massive expansion of output in Asian developing countries have generated growing interest in the crop (FAO 2009, 2010; Scott and Suarez 2012a, 2012b, 2012c). For the private sector, potatoes have captured increased attention because of three, interrelated developments: 1) shifting consumption patterns in urban areas, where the massive increases in future demand will be increasingly concentrated, 2) the prospect of processing the low-value-to-volume tubers into popular snack foods with significant value added along with supplying more fresh tubers to the urban population, and 3) the emerging demand for quality seed to produce the higher-grade raw material required to produce more and higher-priced consumer potatoes and potato products (SAGCOT 2011; dTS 2012). To capitalize on, then sustain the interest of both groups several things need to happen.

Rather than trying to tackle all the constraints—or pursue all the perceived opportunities, simultaneously, the issue now becomes trying to focus the available resources on a prioritized set of initiatives that can be successfully implemented, then monitored as needed to ensure quality control. In that regard, it means ruling out overly ambitious proposals to explore doing anything that might be technically possible (e.g. producing potato starch) when global trends suggest otherwise (Wang 2010; Scott 2011; Scott and Suarez 2012c). Instead, it involves improving and disseminating technology in a few strategic areas.

Mini-tuber production has captured the interest of the public and private sector given the capacity to produce a lot more high quality seed in a much shorter period of time (CIP 2011; Muthoni et al. 2011; dTS 2012). Overcoming the bottleneck required to make more quality seed available is vital for improving productivity and lowering per unit production costs. As scaling up in the use of this technology moves forward, ensuring continued effective collaboration between public and private sector stakeholders not just in cultivating the seed, but in maintaining quality as volumes increase and the quantities marketed multiply will be a key litmus test for maximizing impact on future growth rates. It will also help sustain the coalition of growers´ associations around achieving results (Gildemacher 2010). Furthermore, the question also merges whether there are opportunities for attracting additional foreign investment in this specific area beyond what has happened so far (SAGCOT 2011; dTS 2012).

Beyond the farm gate, building all-weather access roads and telecommunications (cell phones, internet) networks have opened up the market for potatoes in other developing country regions contributing to significant increases in production in the process (Scott 2011; Scott and Suarez 2011). Past research (Scott 1992) and recent anecdotal evidence (KIT 2006) suggests the same principle applies in ECA. Greater market access requires improved flow of goods—inputs and outputs, made possible by better transport and information exchange capabilities.

At the retail level, greater integration of quality, price and nutrition offer some additional opportunities. In that regard, supermarkets proved to be one key catalyst for improving quality and expanding potato consumption in Peru by facilitating better presentation (i.e., tighter grades, cleaner tubers, sorting by variety), more convenient packaging (i.e. in mesh-wrapped lots of different weights) for time-conscious urban adults--by starting with stores catering to wealthier clientele that eventually became the industry standard, and promoting of sales by variety according to their culinary characteristics (Alarcon and Ordinola 2002). More importantly, the advertising and promotional campaigns carried out by the supermarkets in various cities around the country in close collaboration with other stakeholders gave the tuber much greater visibility in the eyes of the average consumer many of whom may only rarely buy potatoes in such stores, but no doubt helped boost consumption from less than 30 kg/yr in 1992 to nearly 80 kg/yr in 2008 (Scott 2011). Publicity about product attributes and prices are part of the supermarkets´ business model. Not many potatoes are currently sold through supermarkets in ECA. However, as urbanization accelerates that seems destined to change as these food retailers attend to the growing interest of more affluent African consumers in health, nutrition and convenience in an effort to capture greater market share. In that sense, encouraging greater supermarket potato initiatives should best be considered as additional private investments intended to go along with and not in lieu of publicly funded projects to improve basic public retail market infrastructure (Tschirley et al. 2004; Hoeffler and Maingi 2005). Given the growing interest in health and nutrition worldwide (Wilkinson and Rocha 2009) particularly among more affluent urban consumers in developing countries (Scott and Suarez 2012a, 2012c), linking quality to the nutritional attributes of potatoes best captured if cooked with skins on (Woolfe 1987) offers another opportunity as supermarkets expand their presence in SSA (Weatherspoon and Reardon 2003) .

Policymakers and private investors—to say nothing of researchers and farmer organizations--in each of these countries would be better served if the various reports, articles, theses, studies by different organizations, carried out in different locations, at different times were regularly integrated into a continuous and coherent flow of information regarding the performance of the potato sector. Or, this information might be posted on a single public platform so that it could be more effectively captured and shared across countries in the same sub-region. One indication that at least some of this may already be underway is the apparent decision to recognize the results of field trials carried out in neighbouring countries for the purpose of speeding up the production of certified seed in Tanzania that in turn prompted a decision to launch a private seed production scheme. Similar exchange of not just research results but operational innovations could provide additional stimuli to interested investors.

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Table 1 Average annual growth rates for potatoes in East and Central Africa, 1961-2010

	2008-2010			Growth rate [a]								
Region/country	Production	Area	Yield	Production			Area			Yield		
	(000Mg)	(000ha)	(Mg/ha)	1	2	3	1	2	3	1	2	3
Africa [b]	17,937	1,518	11.8	4.8	4.5	4.6	3.8	3.7	3.8	0.9	0.8	0.8
Sub-Saharan Africa [c]	9,501	1,185	8.0	4.1	4.7	4.4	3.3	4.6	4.0	0.8	0.1	0.4
East Africa	2,772	457	6.1	3.8	5.3	4.6	4.8	5.2	5.0	-0.7	1.5	0.4
Tanzania	717	140	5.1	12.3	4.5	8.2	8.6	5.6	7.1	3.3	-1.0	1.1
Uganda	685	100	6.8	1.0	7.1	4.0	2.4	6.9	4.7	-1.5	0.2	-0.6
Ethiopia	587	56	10.5	-	-	-	-	-	-	-	-	-
Kenya	483	143	3.4	3.2	0.8	2.0	4.6	2.7	3.6	-1.4	-1.8	-1.6
Sudan [d]	300	18	16.6	-0.8	12.3	5.6	0.4	10.8	5.6	-1.3	1.3	0.1
Central Africa	1,530	164	9.3	4.7	6.1	5.4	2.6	4.4	3.5	1.6	0.6	1.1
Rwanda	1,413	135	10.5	5.9	6.7	6.3	3.0	5.0	4.0	2.8	1.7	2.2
Congo, Dem Rep	94	20	4.6	2.5	5.0	3.8	2.9	5.5	4.2	-0.4	-0.4	-0.4

" – " indicates no data available

[a] 1 = 1984-86 vs 1961-63; 2 = 2008-10 vs 1984-86; 3 = 2008-10 vs 1961-63 where the average annual growth rate is calculated as follows

$$\left[\left(\frac{\text{Ending 3-year average}}{\text{Beginning 3-year average}}\right)^{\frac{1}{\text{Number of years between beginning and end mid-points}}} - 1\right] * 100$$

[b] Africa consists of North Africa and Sub-Saharan Africa which in turn includes the following sub-regions: West Africa, Central Africa, East Africa and South Africa. North Africa is made up of Algeria, Egypt, Libya, Morocco, and the Western Sahara*; West Africa includes Benin, Burkina Faso, Cameroon, Cape Verde, Chad, Côte d´Ivoire*, Gambia*, Ghana*, Guinea, Guinea-Bissau*, Liberia*, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone*, and Togo*; Central Africa is made up of Burundi, Central African Republic, Congo, Equatorial Guinea*, Dem. Rep. of the Congo, Gabon*, Rwanda, and Saõ Tomé and Príncipe*; East Africa consists of Djibouti*, Eritrea, Ethiopia, Kenya, Seychelles*, Somalia*, Sudan[d], Tanzania, and Uganda; South Africa consists of Angola, Botswana*, Comoros, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Rep. of South Africa, Swaziland, Zambia, and Zimbabwe

*According to FAO, these territories reported producing no potatoes during 2008-10

[c] Data for Sub- Saharan Africa include statistics for Malawi based on Ministry of Agriculture and Food Security data for 1994-2010 plus estimates for this study for years 1961-93, Saka (2000), FAO (2008) and not FAOSTAT

[d] FAO does not yet report separate data for Sudan and the Rep of South Sudan

Source: FAOSTAT (accessed May 2012) and calculations for this study unless otherwise indicated

Table 2 Annual average compound growth rates (ACGRs) for potatoes in East and Central Africa, 1961-2010

Years	Production [a]			Area [a]			Yield [b]		
	R^2	ACGR (%)	Significance	R^2	ACGR (%)	Significance	R^2	ACGR (%)	Significance
1961-71	0.85	3.1	***	0.77	2.6	***	0.36	0.1	*
1962-72	0.93	3.7	***	0.80	2.7	***	0.65	0.1	***
1963-73	0.96	4.2	***	0.83	3.3	***	0.70	0.1	***
1964-74	0.98	4.5	***	0.95	4.3	***	0.28	0.1	*
1965-75	0.97	4.8	***	0.94	5.1	***	0.05	0.0	n.s
1966-76	0.91	5.7	***	0.93	6.0	***	0.00	0.0	n.s
1967-77	0.91	5.7	***	0.91	5.7	***	0.01	0.0	n.s
1968-78	0.93	6.2	***	0.92	5.8	***	0.12	0.0	n.s
1969-79	0.91	5.9	***	0.89	5.5	***	0.08	0.0	n.s
1970-80	0.76	4.8	***	0.80	4.6	***	0.07	0.0	n.s
1971-81	0.72	4.5	***	0.80	4.6	***	0.01	0.0	n.s
1972-82	0.72	4.5	***	0.80	4.6	***	0.03	0.0	n.s
1973-83	0.67	3.8	***	0.80	4.1	***	0.00	0.0	n.s
1974-84	0.38	2.4	**	0.75	3.5	***	0.03	0.0	n.s
1975-85	0.37	2.2	**	0.75	3.3	***	0.08	0.0	n.s
1976-86	0.32	1.9	*	0.72	3.1	***	0.10	0.0	n.s
1977-87	0.23	1.6	n.s	0.57	2.8	***	0.09	0.0	n.s
1978-88	0.04	0.6	n.s	0.26	1.7	n.s	0.17	0.0	n.s
1979-89	0.24	2.3	n.s	0.31	2.0	*	0.01	0.0	n.s
1980-90	0.37	3.5	**	0.31	1.9	*	0.26	0.1	n.s
1981-91	0.43	4.4	**	0.30	1.9	*	0.45	0.1	**
1982-92	0.45	4.5	**	0.29	1.8	*	0.48	0.1	**
1983-93	0.54	5.2	***	0.28	1.8	*	0.61	0.2	***
1984-94	0.59	5.5	***	0.36	2.1	*	0.45	0.1	**
1985-95	0.55	5.0	***	0.41	2.4	**	0.24	0.1	n.s
1986-96	0.58	5.2	***	0.62	3.3	***	0.05	0.0	n.s
1987-97	0.60	5.4	***	0.74	4.3	***	0.00	0.0	n.s
1988-98	0.39	3.5	**	0.61	3.4	***	0.05	0.0	n.s
1989-99	0.39	1.8	**	0.61	2.6	***	0.58	-0.1	***
1990-00	0.48	3.0	**	0.65	3.9	***	0.19	-0.1	n.s
1991-01	0.57	4.6	***	0.73	5.3	***	0.00	0.0	n.s
1992-02	0.81	6.7	***	0.87	6.7	***	0.18	0.1	n.s
1993-03	0.85	7.4	***	0.91	7.2	***	0.38	0.1	**
1994-04	0.87	8.0	***	0.91	7.3	***	0.64	0.2	***
1995-05	0.89	8.3	***	0.91	7.4	***	0.73	0.2	***
1996-06	0.87	8.1	***	0.90	7.2	***	0.70	0.2	***
1997-07	0.76	6.7	***	0.87	6.7	***	0.31	0.1	*
1998-08	0.60	5.4	***	0.83	6.3	***	0.08	0.0	n.s
1999-09	0.44	3.0	**	0.82	4.8	***	0.00	0.0	n.s
2000-10	0.43	2.1	**	0.92	3.7	***	0.01	0.0	n.s

*** = Significant at 1% level; ** = Significant at 5% level; * = Significant at 10% level; n. s. = not significant

[a] Calculated using the following expression: $\ln Y = \ln b_0 e^{b_1 t}$, *i.e.* $\ln(Y) = \ln(b_0) + b_1 t$; where, Y = Variables (Production and Area); ln= natural log; and $b_1 = \mathrm{ACGR}$

[b] As log exponential model proved inappropriate, R^2, ACGR and significance for yield are calculated using a simple linear model

Source: FAOSTAT (accessed August 2012) and calculations for this study

Table 3 Distribution of potato-producing countries in Sub-Saharan Africa 2008-10

Production (Mg) /yr	West [a]	Central [a]	East [a]	South [a]	Total
0 or no data	7	3	3	1	14
> 0 <10,000	4	3	1	2	10
> 10,000 < 50,000	5	0	0	3	8
> 50,000 <250,000	1	1	0	4	6
>250,000	1	1	5	3	15
Total	18	8	9	13	48

[a] See Table 1 for details about the classification of countries by sub-region

Source: FAOSTAT (accessed May 2012) and calculations for this study

Table 4 Average annual growth rates for major food crops in East and Central Africa, 1961-2010

	2008-2010			Growth rate[a]								
Region[b]/country	Production	Area	Yield	Production			Area			Yield		
	(000Mg)	(000ha)	(Mg/ha)	1	2	3	1	2	3	1	2	3
Sub-Saharan Africa [c]												
Cassava	120,823	11,911	10.1	2.6	3.1	2.9	1.3	1.9	1.6	1.2	1.2	1.2
Maize	52,156	28,839	1.8	2.3	3.1	2.7	1.3	1.6	1.5	0.9	1.5	1.2
Yams	47,723	4,580	10.4	1.6	6.2	3.9	1.9	4.3	3.1	-0.3	1.8	0.8
Plantains	26,788	4,303	6.2	2.4	1.9	2.2	2.3	0.9	1.6	0.2	1.0	0.6
Sorghum	22,190	25,551	0.9	1.4	2.0	1.7	1.3	1.6	1.4	0.1	0.4	0.2
Potatoes (11)	9,501	1,185	8.0	4.1	4.7	4.4	3.3	4.6	4.0	0.8	0.1	0.4
East Africa												
Maize	11,976	7,745	1.5	3.5	2.8	3.1	1.9	2.4	2.2	1.5	0.4	0.9
Cassava	11,134	1,393	8.0	4.0	-0.1	1.9	0.7	0.8	0.7	3.2	-0.8	1.1
Plantains	10,951	2,014	5.4	2.2	1.6	1.9	2.6	1.3	2.0	-0.4	0.3	0.0
Sweet potatoes	5,556	1,199	4.6	4.2	3.2	3.7	4.8	2.5	3.6	-0.6	0.7	0.1
Potatoes (7)	2,772	457	6.1	3.8	5.3	4.6	4.8	5.2	5.0	-0.7	1.5	0.4
Central Africa												
Cassava	19,288	2,501	7.7	2.4	0.2	1.3	1.4	0.1	0.8	0.9	0.1	0.5
Plantains	4,493	724	6.2	3.0	0.1	1.5	2.7	0.2	1.4	0.2	-0.1	0.1
Maize	1,776	1,946	0.9	3.2	2.0	2.6	2.3	1.9	2.1	0.9	0.1	0.5
Sweet potatoes	1,725	321	5.4	1.9	-0.3	0.7	2.0	0.3	1.1	-0.1	-0.6	-0.3
Potatoes (5)	1,530	164	9.3	4.7	6.1	5.4	2.6	4.4	3.5	1.6	0.6	1.1

( ) indicates the order of importance in terms of volume of production

[a] 1 = 1984-86 vs 1961-63; 2 = 2008-10 vs 1984-86; 3 = 2008-10 vs 1961-63 where the average annual growth rate is calculated as follows $\left[\left(\frac{\text{Ending 2-year average}}{\text{Beginning 2-year average}}\right)^{\frac{1}{\text{Number of years between beginning and mid-points}}} - 1\right] * 100$

[b] Sub-Saharan Africa consists of Africa less North Africa. See Table 1 footnote b for details about each sub-region

[c] Data for Sub- Saharan Africa include statistics for Malawi based on Ministry of Agriculture and Food Security data for 1994-2010 plus estimates for this study for years 1961-93, Saka (2000), FAO (2008) and not FAOSTAT

Source: FAOSTAT (accessed June 2012) and calculations for this study unless otherwise indicated

Table 5 Food Balance Sheets for potatoes in East and Central Africa, 1961-63 to 2007-09[a]

Region [b]		1961-63	1976-78	1991-93	2007-09
Sub-Saharan [c]	Domestic supply (000 Mg)	1,258	2,486	4,341	9,047
	Food (%)	73	75	78	75
	Feed (%)	3	3	3	3
	Seed (%)	14	12	9	11
	Processing (%)	0	0	0	0
	Other uses (%) [d]	9	10	10	11
East Africa	Domestic supply (000 Mg)	552	1,097	1,916	2,773
	Food (%)	79	77	80	76
	Feed (%)	0	0	0	0
	Seed (%)	11	12	9	12
	Processing (%)	0	0	0	0
	Other uses (%) [d]	10	11	10	12
Central Africa	Domestic supply (000 Mg)	107	227	335	1,188
	Food (%)	72	81	83	86
	Feed (%)	0	0	0	0
	Seed (%)	23	15	12	10
	Processing (%)	-	-	-	-
	Other uses (%) [d]	5	4	5	4

[a] Totals may not sum due to rounding

[b] See Table 1 for the classification of countries by sub-region

[c] Derived from data for Sub- Saharan Africa that include statistics for Malawi based on Ministry of Agriculture and Food Security data for 1994-2010 plus estimates for this study for years 1961-93, Saka (2000), FAO (2008) and not FAOSTAT

[d] According to FAOSTAT "other uses" refers to "waste" and "other uses"; in previous years it referred only to waste (Anonymous 1995; Horton 1988)

Source: FAOSTAT (accessed August 2012) and calculations for this study

Table 6 Average per capita food supply (kg/yr) of selected food commodities in Sub-Saharan Africa 1961-2009

Region [a]	1961-63	1971-73	1981-83	1991-93	2001-03	2007-09
Sub-Saharan Africa [b]						
Cassava	103.5	97.7	95.2	109.0	92.3	75.9
Fruits	52.0	54.6	54.6	53.3	53.5	52.8
Maize	36.6	36.5	38.3	42.8	41.0	39.8
Meat	13.6	13.6	14.1	13.4	13.6	14.8
Milk	27.1	29.3	33.2	27.9	30.7	33.2
Potatoes	4.0	4.8	5.7	6.4	9.0	8.5
Sorghum	29.1	22.1	20.1	20.7	20.7	20.7
Sweet Potatoes	11.7	11.7	12.0	10.7	15.9	16.7
Wheat	10.2	14.4	17.2	17.2	20.9	23.2
East Africa						
Cassava	59.5	50.4	64.2	57.1	35.0	35.1
Fruits	37.8	35.7	45.4	44.0	51.7	55.1
Maize	30.9	33.0	39.2	39.3	41.5	39.4
Meat	15.7	14.1	13.5	11.7	11.5	11.9
Milk	41.9	39.0	47.7	47.3	58.8	62.0
Potatoes	6.5	6.3	7.7	9.5	11.2	8.4
Sorghum	28.3	25.0	25.9	24.0	23.1	23.9
Sweet Potatoes	13.3	17.8	17.8	14.3	18.9	20.1
Wheat	12.4	14.6	14.8	19.1	24.4	25.9
Central Africa [c]						
Cassava	63.2	61.5	52.3	34.2	39.4	35.4
Fruits	45.7	48.7	46.2	35.8	37.1	36.7
Maize	5.8	6.5	5.9	5.8	4.8	5.6
Meat	3.1	3.3	3.9	4.4	4.0	4.5
Milk	2.6	3.2	4.9	4.7	4.1	4.1
Potatoes	3.0	4.3	5.4	4.8	12.4	11.3
Sorghum	5.0	3.8	4.2	2.3	2.4	2.0
Sweet Potatoes	27.6	23.0	29.7	26.1	23.3	17.2
Wheat	1.3	2.1	3.4	3.7	3.9	4.7

[a] See Table 1 for details about the classification by sub-region
[b] Data for Sub- Saharan Africa include statistics for Malawi based on Ministry of Agriculture and Food Security data for 1994-2010 plus estimates for this study for years 1961-93, Saka (2000), FAO (2008) and not FAOSTAT
[c] For 2007-2009, there are no data for the Dem Rep of the Congo

Source: FAOSTAT (accessed June 2012) and calculations for this study unless otherwise indicated

Table 7 Trade volumes and values for potatoes in East and Central Africa, 1984-86 versus 2007-09 [a]

Region/Country	Imports 1984-86 (000 Mg)	Imports 2007-09 (000Mg)	Imports 2007-09[b] (000 €)	Exports 1984-86 (000 Mg)	Exports 2007-09 (000 Mg)	Exports 2007-09 [b] (000 €)
			Potatoes			
Sub-Saharan Africa [c]	50	255	54,331	11	53	10,088
West Africa	28	134	20,657	1	2	246
Senegal	11	71	7,542	1	0	12
Ivory Coast	9	19	4,381	0	0	44
East Africa	3	21	6,405	4	13	1,766
Central Africa	4	2	939	0	1	191
South Africa	15	98	26,330	6	36	7,886
Swaziland	0	6	1,667	0	0	51
			Frozen potatoes [d]			
Sub-Saharan Africa [c]	0	85	24,199	0	6	1,499
West Africa	0	16	4,060	0	1	52
East Africa	0	1	471	0	1	72
Central Africa	0	6	1,992	0	1	24
South Africa	0	62	17,677	0	4	1,351
Rep of South Africa	0	53	13,530	0	4	1,270
			Potato flour [d]			
Sub-Saharan Africa [c]	3	67	5,831	0	20	4,007
West Africa	1	7	1,141	0	0	3
Central Africa	0	30	534	0	0	14
East Africa	0	13	1,054	0	1	504
South Africa	1	17	3,101	0	19	3,486
Total	53	407	84,361	11	79	15,594

[a] Totals may not sum due to rounding; all data are on fresh weight equivalent (FEW) basis, see below for conversion rates

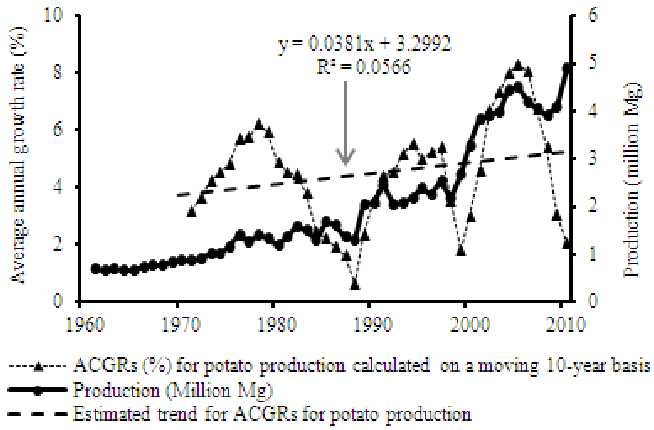
[b] Based on an average exchange rate US$ to Euros € (2007-2009) of 0.7043 (Forex Trading and Exchange Rates Services;https://www.oanda.com)

[c] See Table 1 for details about the classification by sub-region

[d] Fresh weight equivalent with a conversion rate of 2:1 for frozen potatoes and 5:1 for potato flour

Source: FAOSTAT (Accessed August 2012)

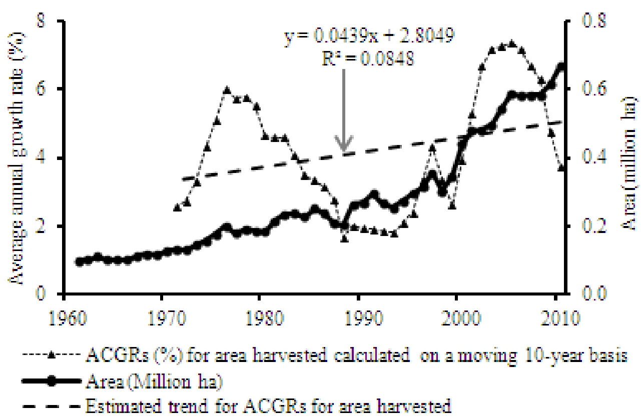
Fig. 1 Potato production and ACGRs for production in East and Central Africa, 1961-2010[a]



[a] Data points for the ACGRs are taken from Table 2; see Table 2 for details. *Double asterisks* R^2 for the estimated trend line is significant at the 1% level

Source: FAOSTAT and calculations for this study

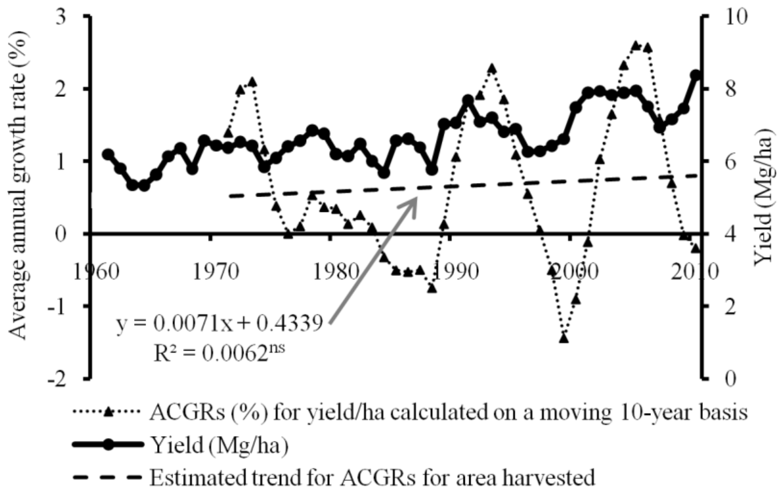
Fig. 2 Area harvested for potato and ACGRs for area in East and Central Africa, 1961-2010 [a]



[a] Data points for the ACGRs are taken from Table 2; see Table 2 for details. *Double asterisk* R^2 for the estimated trend line is significant at the 1% level

Source: FAOSTAT and calculations for this study

Fig. 3 Yield/ha for potato and ACGRs for yields in East and Central Africa, 1961-2010 [a]



[a] Data points for the ACGRs are taken from Table 2; see Table 2 for details. *ns* R^2 for the estimated trend line means not significant

Source: FAOSTAT and calculations for this study

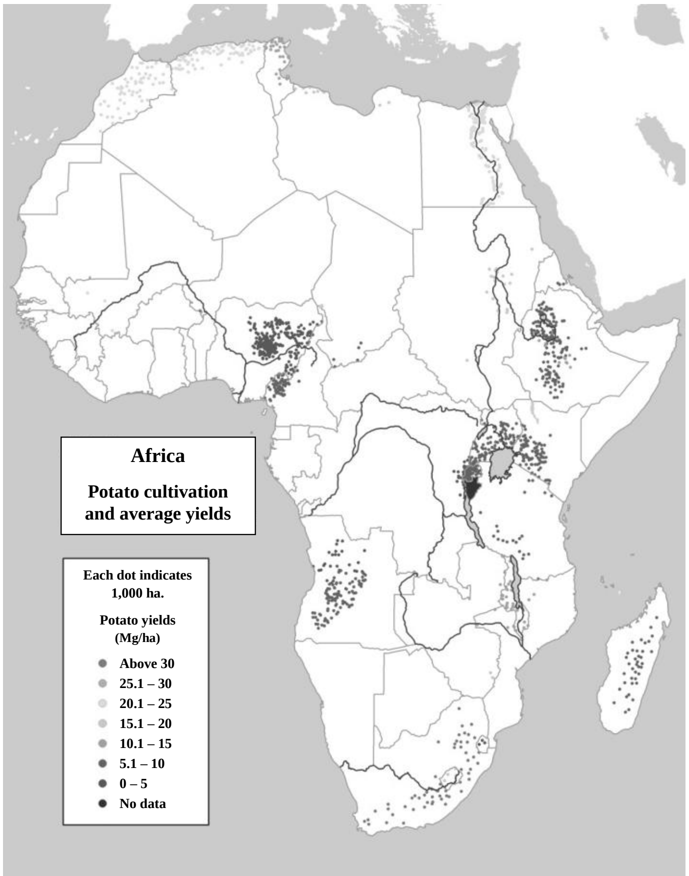


Fig 4. Potato production in Africa

Source: CIP´s Research Informatics Unit

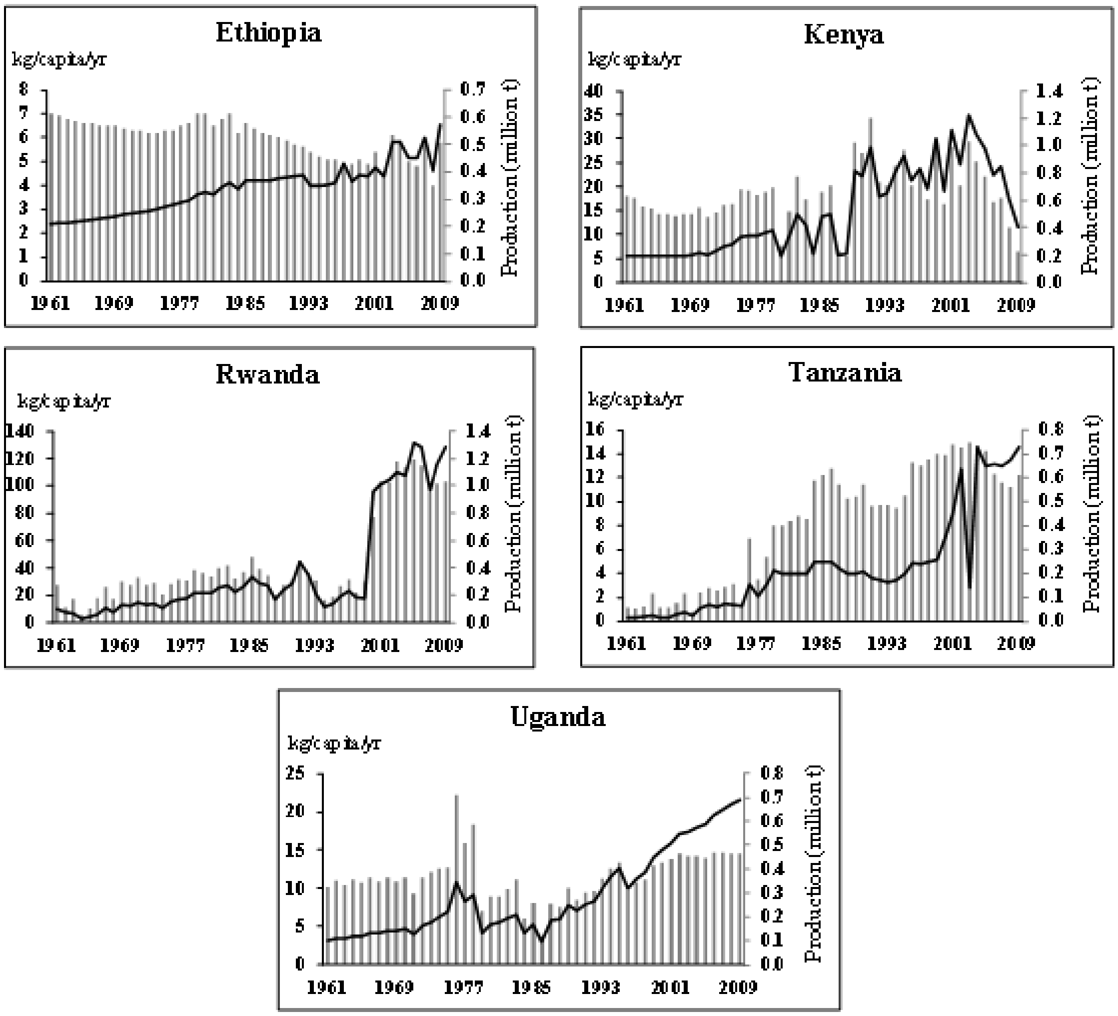


Fig. 5 Annual average potato consumption and total potato production for selected countries in East and Central Africa, 1961-2009

Source: FAOSTAT (accessed July 2012)