

Performance and growth prospects of Irish potatoes as a component for the development of strategic exports in Uganda

R.S.B. Ferris, G. Okoboi, C. Crissman,
P. Ewell, and B. Lemaga

ASARECA
Monograph 2



About ASARECA

The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) is a nonpolitical organization of the national agricultural research institutes (NARIs) of ten countries: Burundi, D.R. Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania, and Uganda. It aims at increasing the efficiency of agricultural research in the region so as to facilitate economic growth, food security, and export competitiveness through productive and sustainable agriculture.

Background

The background to regional collaboration in agricultural research can be traced to the early 1980s when scientists from the national programs began working together. To run these networks, regional steering committees were put in place to consider and approve annual work plans. Membership was drawn from the national coordinators for research, as well as the scientists from the international research centers. With time, these early networks evolved and came to be regarded as one way of achieving economies of scale and facilitating technology spill-overs across national boundaries. It was upon this that the idea of a regional association was initiated and built.

Given the many commodities and factors which each national system had to handle and the need for increased efficiency and effectiveness in utilizing scarce resources, it was agreed that a regional strategy for agricultural research and research-related training be implemented. So, in September 1994, the Memorandum of Agreement that established ASARECA was signed and in October, that same year, the Executive Secretariat became operational and is based in Entebbe, Uganda. The directors of the national agricultural research institutes in the ten member countries constitute the Committee of Directors, which is the highest governing body. The Committee provides policy oversight while the Executive Secretariat services it and implements its decisions under the guidance of the Chairman.

Research Networks

ASARECA carries out its activities through regional research networks, programs, and projects. Twelve of these are currently operational with seven due to begin operations in the next several months. However, it is important to note that before ASARECA came into existence, there was already some collaborative research within the region. This was brought under the ambit of ASARECA when it was established and it is carried out by the first-generation networks. These are the research networks on potato and sweetpotato, agroforestry, root crops, and beans. The second-generation networks are those established in the 1990s; they are the research networks on banana, postharvest processing, animal agriculture, maize and wheat, highlands, technology transfer, agricultural policy analysis, and electronic connectivity. The new networks under planning are those on rice, plant genetic resources, sorghum and millet, soil and water conservation, coffee, agricultural information, and strengthening the capacity of NARIs to manage regional programs.

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February 2002

**Prepared by IITA-FOODNET, CIP, PRAPACE, CGIAR,
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ISBN 978-131-210-6

Printed in Nigeria by IITA

Correct citation: Ferris, R.S.B., G. Okoboi, C. Crissman, P. Ewell and B. Lemaga. 2003. Performance and growth prospects of Irish potatoes as a component for the development of strategic exports in Uganda. ASARECA/IITA Monograph 2. IITA, Ibadan, Nigeria. 44pp

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Acronyms and abbreviations

ACDI	Agricultural Cooperative Development International
AHI	African Highlands Initiative
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
BW	bacterial wilt
CEDO	community enterprise development organization
CIAT	International Institute for Tropical Agriculture (Columbia)
CIP	International Potato Center
CLUSA	Cooperative League of the United States of America
COMESA	Common Market for Eastern and Southern Africa
COMPETE	Competitive Private Enterprise and Trade Expansion Project
DES	Dar-es-Salaam, Tanzania
DRC	Democratic Republic of Congo
ECAPAPA	Eastern and Central African Program for Agricultural Policy Analysis
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	FAO statistical database
FOODNET	Marketing and postharvest research network for eastern and central Africa
IDEA	Investment in Developing Export Agriculture (USAID–Agribusiness Center)
IITA	International Institute of Tropical Agriculture (Nigeria)
KARI	Kenyan Agriculture Research Institute
KGL	Kigali, Rwanda
LB	late blight
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MOA	Ministry of Agriculture
MZ	Mwanza, Tanzania
NAADS	National Agricultural Advisory and Development Service
NARO	National Agricultural Research Organization, Uganda
NPRC	National Potato Research Center, Tigoni, Kenya
NRI	Natural Resources Institute (UK)
PRAPACE	Eastern and Central African Irish Potato and Sweetpotato Network
PSF	Private Sector Foundation
SPEED	Support for Private Enterprise Expansion and Development
SWARP	South Western Uganda Agricultural Rehabilitation Project
UNSPPA	Uganda National Seed Potato Producers Association
USDA	United States Department of Agriculture
Ush	Ugandan shillings (February 2002, US\$1 = Ush 1700)
W/S	wholesale price
WTO	World Trade Organization

Executive summary

The purpose of this report is to provide an overview of the Irish potato marketing system in Uganda and an analysis of the role for Irish potatoes within the Government of Uganda's newly devised export strategy. Unlike the other commodities included in this strategy, exports of potatoes would be an entirely new venture and therefore unable to capitalize on existing marketing channels or opportunities. In order to develop this sector into the export class, several technical, infrastructural, and organizational improvements need to be designed, developed, and implemented before this venture can be successful.

Trade in Irish potato products accounts for about 4% of world production, a proportion similar to that of rice. The international market for potatoes has five main segments: (1) seed potatoes, (2) ware potatoes, (3) frozen chips, (4) crisps and other potato snacks, and (5) starch. World exports of frozen chips are valued at US\$2 billion, that of fresh potatoes at US\$1.8 billion (FAOSTAT), and trade in seed potatoes is valued at US\$400 million (worldseed.org). The frozen chip market grew rapidly in the past decade and exceeded the value of fresh potato exports for the first time in 1998. Frozen chips will continue to be the leading area of growth in the potato trade in the next decade.

Like those of many other commodities in Uganda, the Irish potato sector is not well organized or integrated. Producers, transporters, marketers, wholesalers, and retailers are fragmented and tend not to cooperate. There are very few organizations and those that do exist are small and young. The lack of organization is one factor that isolates the sector from regional or global markets.

In Uganda, potatoes are essentially a food security crop with a steadily growing urban domestic market. Projections for future growth are somewhat obscured by a lack of sound empirical data on production and demand. According to FAO statistics, the production of potatoes in Uganda (2000) was approximately 450 000 t, produced on approximately 65 000 ha with an average yield of 7 t/ha. However, a recent study by the national potato program estimated production up to 1.2 million t/year, with on-farm yields of 14.5 t/ha, whereas the most recent household survey produced a production total of 290 000 t, with a yield of 4 t/ha.

Ugandan potato production is constrained by a lack of inputs including clean seed, fertilizers, and pesticides. There are only a few commercial stores and no cold-store facilities. There is a general lack of organization in the marketing chain, particularly amongst producers. Combined with seasonal production, this leads to considerable price instability. Due to lack of transparency and poor market structure, brokers are able to charge excessive fees for their services and travelling traders make the bulk of the profit in the supply chain.

Population growth and urbanization are the main drivers for demand, and the increased consumption is supplied mainly through an expansion in production in the midaltitude zone where potatoes are promoted as a cash crop. Some observers view the rapid expansion of potato production into the lower areas with reservation due to the risks of large-scale, cyclical crop failure through diseases such as bacterial wilt and late blight.

Avoiding crop failure and maintaining product quality can be achieved effectively through an efficient clean seed supply system, linked to informed producer groups. At present, only one association is undertaking seed production and marketing in Uganda and limited seed stocks of less than 100 t/year are sold at five times the price of ware potatoes.

Prospects for major positive changes in the Ugandan potato export market should be considered in relation to the market opportunities. Uganda has no competitive advantage to enter the frozen chips market, due to lack of infrastructure and distance from important markets, also lack of the economies of scale that are required. Prospects for the production of high quality crisps and snacks to supply the domestic market are relatively good, as long as product quality can compete with imported goods. Expansion into the ware potato market should be analyzed against three market options. These are (1) "export quality" tubers to supply fast-food outlets, restaurants, and the tourist trade, (2) premium grade potatoes to supply the premium, middle-class urban market that is being led through retail outlets such as Shoprite, and (3) standard grade tubers to supply the bulk food security market. It may be possible to explore some limited sales of high quality tubers into the regional ware markets. However, an export market for seed potatoes to neighboring countries is less likely.

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Potato markets: local to global

Potatoes in Uganda are essentially a food security crop with good prospects for increased domestic urban demand. The bulk of the crop is grown in the highland areas of southwest Uganda in two districts, Kabale and Kisoro. In these districts, potatoes are both a staple food and a main source of income. Virtually all households in southwest Uganda cultivate potatoes, producing over 60% of the national crop. Across the country, there are approximately 200 000 households producing potatoes on plots of less than one ha. There are no irrigated commercial farms. Due to increased demand, particularly urban demand, potato production is expanding in the three traditional production zones and is spreading into central Uganda.

Production of potatoes in Uganda is entirely for the domestic market. Opportunities for regional and global trade exist but are limited. A recent regional survey found there is some cross-border trade with Rwanda, but this trade is opportunistic and only fills short-term seasonal windows. There are no organized export links to any other countries and potatoes cannot be considered a source of foreign exchange for Uganda.

There are a number of constraints to production and marketing of potatoes in Uganda that also apply to most staple food crops produced by resource-poor farmers. Farmers do not use clean seed, and although there are no taxes on agricultural inputs, few farmers use fertilizer or pesticides. Local marketing of the crop is inefficient due to lack of cooperation amongst farmers and collusion amongst traders and retailers. The market has low investment, little segmentation, and suffers from poor infrastructure in terms of irrigation, storage, and market roads. Transportation costs from the main production zones are relatively high. There are no grades and standards at the market and, therefore, market signals based on premium prices are weak.

Market opportunities for Ugandan potatoes are exclusively focused on domestic opportunities and the current plan for developing an export drive is based on a production strategy with little attention being paid to the marketing options. Whilst most of the interventions planned for the potato sector in the export strategy document are to be encouraged, these activities are more likely to strengthen food security and local marketing rather than boost foreign exchange earnings. In a recent regional potato survey, market conditions were as described on page 2.

Domestic seed potatoes

Sales of seed potatoes in Uganda are extremely limited with production at less than 100 t/year. The Uganda National Seed Potato Producers Association (UNSPPA) is the only organized supplier of seed potatoes. Currently, the public sector has no facilities to produce clean prebasic seed and supplies of tissue-cultured materials are obtained directly from Kenya via the International Potato Centre (CIP) and the Kenyan Agricultural Research Institute (KARI). Investment in improved facilities to produce basic seed would be of great benefit to the sector and is an essential first step in supporting increased production and improved quality.

Domestic ware potatoes

Most potatoes are sold into the ware market as an ungraded product. The marketing system is not well organized with most farmers being price-takers and retailers paying high prices due to the collusion of traders. More competitive production and increased transparency in the market through market information and improved organization of producers would strengthen the position of farmers to negotiate better prices. Clearly defined market segments would also assist farmers to make investments for standardized products with known premiums. Over time, consumers would also benefit from a range of priced products based on quality-related standards.

Regional seed and ware potatoes

At present, there are few trading links between any of the countries in the Lake zone and no country has made a concerted effort to supply a neighboring country with either seed or ware potatoes. The Government of Uganda's export strategy does not identify which country or market segment it intends to supply; it would seem prudent to develop a detailed marketing plan prior to any campaign for increased production, if the potato sector is to avoid simply oversupplying its domestic market.

Export from Uganda

Uganda is currently not able to profitably supply the Kenyan markets as most trading is done in Nairobi and transport costs would make this prohibitive. Uganda has limited trade with Rwanda and this is unlikely to increase. Uganda has no links with markets in Tanzania, although there are possibilities of supplying Mwanza via transport across the lake. Links to the Democratic Republic of Congo (DRC) and Sudan have not been explored.

Export from Rwanda

Rwanda is a traditional supplier of potatoes to Burundi and to Kivu in the DRC. Although the quality of Rwandan potatoes is generally poor, Burundian potatoes are of an even lower quality. As part of the national rehabilitation program, the Government of Rwanda is planning to reestablish its potato sector. Studies have shown there are good export prospects to supply Burundi and the DRC, with some potential to supply Uganda and Tanzania. The Rwandan export plan will include supplies of both seed and ware potatoes. Rwanda has a strong comparative advantage in potato production due to its high altitude and long-term

links with potato production. The country already has tissue culture and screenhouse facilities for the production of prebasic and basic seed and the extension service is planning to promote the use of improved seed, fertilizer, and pesticide through a national demonstration program. This campaign will be supported through a USAID-funded agribusiness program.

Export from Kenya and Tanzania

Kenya and Tanzania are the only countries in the region which have a regular trade in potatoes. The Nairobi market provides regular supplies to Mwanza and potatoes are supplied to Nairobi from Arusha as part of a cost-saving, back load system. These markets are essentially based on the most efficient transport links and regular trade routes. Kenya has a strong potato program, with tissue culture and basic seed production facilities. There are no plans at this time to significantly strengthen the potato sector, but the sector is fairly robust and there is strong demand for potatoes in Nairobi.

African market

Four countries in Africa are dominant in potato production: Egypt, Algeria, South Africa, and Morocco together produce 65% of the crop (Fig. 1). These are also the leading countries in the potato trade. Links to the European and Middle Eastern markets are well developed and likely to grow as demand increases for processed and niche market potato products. The production is highly intensive and irrigated, with yields in excess of 40 t/ha. South Africa is already exporting frozen chips to its fast-food chains in Uganda.

In 1999, the total export value of fresh potatoes from Africa was US\$85.9 million and the same four countries accounted for 97% of that value. The value of exports of frozen potatoes from Africa was US\$6.5 million and Egypt and South Africa accounted for 85% of that value.

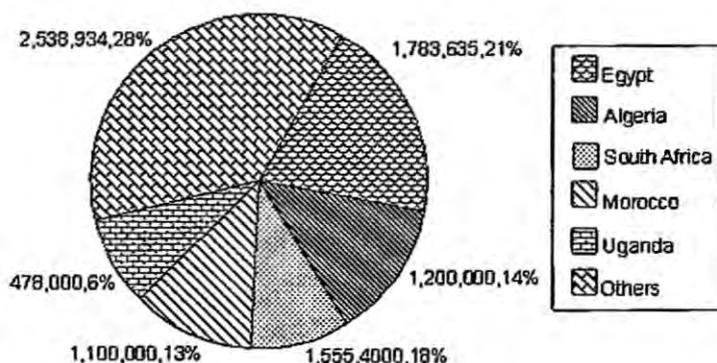


Figure 1. Major potato producers in Africa in 1997.

Source: FAOSTAT 2002. Agriculture database.

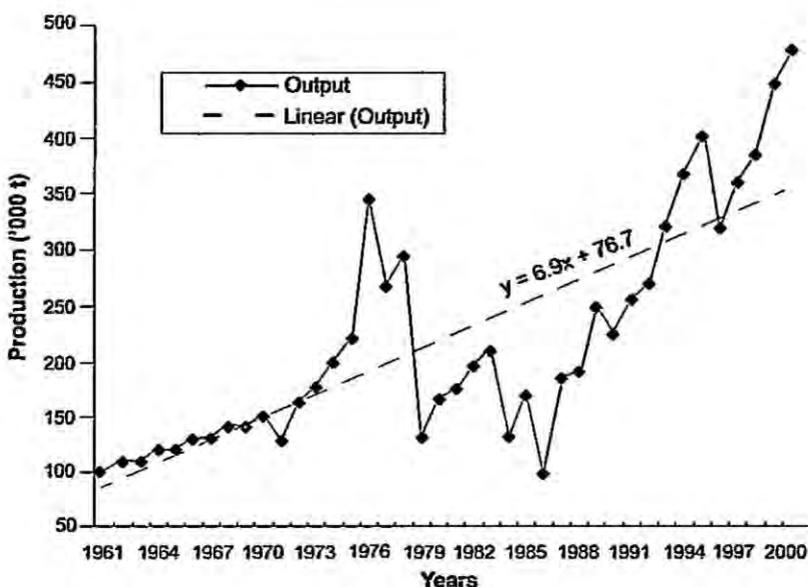


Figure 2. Potato production ('000 t) in Uganda, 1960–2000.

Source: FAOSTAT 2002. Agriculture database.

Global market

Global trade in fresh potatoes is dominated by the European countries (67%) and the USA and Canada (11%). Most of this trade is among those countries. The Netherlands is the world leader in the frozen chips trade and together with the USA, Canada, and Belgium accounts for 85% of world trade. These countries have highly sophisticated, vertically integrated market chains for all market segments and are likely to increase their market share through the consolidation of competing companies.

Production

According to figures from the Ministry of Agriculture (MOA) and FAO, Uganda produces approximately 450 000 t of ware potatoes from 65 000 ha with an average yield of 7 t/ha. We estimate that approximately 200 000 to 300 000 farmers are involved in potato production. Most are poor farmers with farms of 1–2 ha in the highland areas of the country. Between 1961 and 1976, production increased from 100 000 to 345 000 t (Fig. 2). Between 1976 and 1985, this trend was interrupted by the civil wars of 1979 and 1981–1986.

Since 1986, potato production in Uganda has increased by 14% per annum, from 98 000 t in 1986 to 478 000 t in 2000, one of the highest growth rates of any food crop in the country (Annex 1).

Observers attribute this increase to a combination of political stability, increasing population, the introduction in 1991 of new potato varieties (named *Victoria*, *Kabale*, and *Kisoro*) and an expansion of production into midaltitude production zones. In western Uganda, development organizations including the South Western Reconstruction

Project (SWARP), the African Highlands Initiative (AHI), Eastern and Central African Irish Potato and Sweetpotato Network (PRAPACE), and AFRICARE have heavily promoted potato production. These agencies encouraged increased potato production by providing farmers with clean seed, production skills, and enhanced market access through construction of feeder roads.

As with most production figures, there is a debate on the correct levels of production, which makes projections less reliable. Whilst figures from FAO show a strong growth in the potato sector, agencies such as the National Potato Program suggest that potato production in Uganda is significantly higher than official statistics reveal. According to results from Kalengyere Research Station, new varieties can yield up to 25 t/ha on the research station with an expected 14.5 t/ha under farm conditions.

Other research recorded on-farm yields of more than 20 t/ha (Low 2000). A recent study by National Agricultural Research Organization (NARO) (2001), concluded that total production was approximately 1 million t of potato from 60 000 ha, with corresponding figures for 2001 at 1 234 197 t from 80 395 ha (Annex 2, Wagoire et al. unpublished). The most recent household survey contradicts these figures with values of 290 000 t from 70 000 ha, suggesting a production of 4 t/ha and discussions with farmers, on bags/ha, tend to confirm the lower yield levels.

These huge differences in estimated production are most likely due to the different data collection methods. The national estimates devised by MOA and FAO are based on census data that are projected thereafter, based on growth factors. Although many observers criticize these figures, the data collection method has the advantage that a similar method is used across countries (Annex 3). For the purposes of this study, we will use the FAO statistics. These align with the Government of Uganda's export plan that seeks to double production to 1 million t/year.

Production zones

Potatoes have traditionally been cultivated in the highland areas of Uganda, 1500–3000 m a.s.l. The major production zones are the Kigezi highland districts of Kabale and Kisoro in the southwest that produce the bulk of the crop in Uganda, Mbale, and Kapchorwa districts on the slopes of Mount Elgon, and Nebbi district, a midaltitude region in north-western Uganda that has more recently started to promote potato production. See Map 1.

The traditional production zones of Kigezi and Mount Elgon are favorable for potatoes production. This is due to their deep volcanic soils, high altitudes with mild temperatures (10–30 °C) and abundant rainfall (900–1400 mm).

These high altitude zones also have reduced risk of disease. Late blight (LB) and bacterial wilt (BW) are associated with lower temperatures at higher altitudes.

Kabale district alone produces between 50 and 60% of the total annual ware potato consumed in Uganda (Fig. 3).

Kabale district lies within an altitude range of 1400–2500 m a.s.l. and has an annual rainfall from 1000 to 1500 mm that occurs in two peaks from March to May and from

September to November. The mean annual maximum temperature is below 22.5 °C with an annual minimum below 10 °C, making Kabale one of the coldest districts in Uganda (Low 2000).

The physical and climatic conditions of the mountainous districts of Kisoro, Mbale, and Kapchorwa are similar to those in Kabale. Many potato farmers in Mwizi and Mbarara are migrants from Kabale who brought their potato producing habits to the region. So although the hills of Mwizi in Mbarara have a relatively lower altitude (1200–1600 m a.s.l.) and the rainfall (800–1100 mm) range is lower than that of Kabale, potato production is important. Other districts in Uganda that have the potential to sustain potato production include Kisoro, Bushenyi, Kasese, Kabarole, Mubende, Nebbi, Kapchorwa, Mbale, and Kibale.

Seasonality

Kabale farmers have three potato growing seasons and are able to produce almost all year round. They do this by intensive use of all available hills, slopes, swamps, and valley bottoms. The Kabale potato cultivation calendar (Table 1) shows typical planting and harvesting times. On the hills, the first season starts from mid-February during the short rains and is harvested in June. The second season crop is planted during the longer rains from September to November and represents the main commercial crop. During the short dry season, farmers also plant in valley bottoms that are swampy from April to May, and harvest from August. In the valley, the planting season follows on from the hills through December and January; the harvest is in March and April. This combination of sites and rainfall patterns ensures that there are only a limited number of weeks when markets supplies are low.

In Kisoro and Mwizi (Mbarara), potato production closely follows the same pattern as that of Kabale except that these districts do not have swampland for irrigated production (Table 2). Therefore, these districts only have two major potato seasons, with the minor season starting in February with the harvest in May, and the main season starting in September with the harvest in January. For Mbale and Kapchorwa districts, the first season is between March (planting) and June (harvesting), while the second season starts from August and ends in December. The combination of production seasons assures that Uganda is able to provide ware potatoes nearly all year round.

There is one period from late August to early November when supplies are low and prices are high. This provides an opportunity for neighboring countries such as Rwanda to sell potatoes to Uganda. During this period, potato prices at Owino market in Kampala are relatively high (Ush 28 000/bag), hence making it possible for Rwandan potatoes to be sold profitably.

The marketing windows that provide neighboring countries with the ability to export to Uganda suggest that some research could be done on staggered planting or simple irrigation schemes to enable some farmers to fill these gaps and gain from highest market prices in the off-season.

Table 1. Potato production calendar for Kabale district.

Area of cultivation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Hill slopes	Harvesting	Potato planting	Potato planting	Potato harvesting					Potato planting	Potato planting		Harvesting
Swamp land					Potato planting			Harvesting				
Valley bottom	Potato planting		Harvesting									Potato planting
Mean monthly rainfall 1990–2000 (mm)	72.3	73.1	136.5	114.9	98.4	43.0	13.7	56.4	88.8	131.4	98.4	90.0

Source: FEWSNET Metrological data 1995–2000 and own calculations from field.

Table 2. Potato production calendar for Kisoro, Mbarara, Mbale, and Kapchorwa districts.

District (s)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Kisoro and Mbarara	Harvesting	Potato planting	Potato planting	Harvesting	Harvesting				Potato planting	Potato planting		Harvesting
Mbale and Kapchorwa			Potato planting	Potato planting		Harvesting	Harvesting	Potato planting	Potato planting		Harvesting	
Rainfall (mm) 1994 Mbarara	100.2	30.8	85.9	68.7	164.9	6.1	6.0	31.6	29.1	128.8	156.2	104.4

Source: FEWSNET Metrological data 1995–2000 and own calculations from field.

Potato varieties

Due to the concerted efforts of the National Potato Program working in collaboration with CIP and PRAPACE, Ugandan farmers have access to a range of improved potato varieties. Farmers in Uganda are growing all of the varieties listed in Table 3. However, *Nakpot* 1, 2, and 3 that have good commercial and disease resistance qualities are only recently released and have a very limited distribution. To increase the availability of the *Nakpot* lines, the national program intends to focus on these varieties in their first phase of seed production.

Victoria is the most common commercial variety. It is high yielding, early maturing, tolerant to BW but susceptible to LB. Farmers in Mbarara, Kabale, and Kisoro quickly adopted this variety through promotion by SWARP and AHI.

Uganda Rutuku was introduced in Uganda in 1972. It is one of the most successful varieties in Kabale. *Uganda Rutuku* is very popular with traders for its chip-making quality. Mainly grown in Kabale at elevations above 1800 m, this variety sells at a premium price. The survey revealed that the wholesale price of a bag (100 kg) of *Uganda Rutuku* was Ush 33 000 while that of *Victoria* and other varieties was Ush 28 000 in Owino market. Because *Victoria* has characteristics similar to those of *Uganda Rutuku* (large tuber size, red/light red skin color, and yellow/cream flesh), unscrupulous traders in Owino are said to be selling *Victoria* as *Uganda Rutuku* to unsuspecting buyers.

Given the strong demand for specific varieties and the fact that unfair trading practices exist in the market, there would seem to be merit in developing grades and standards around more clearly defined market segments, so that farmers can be rewarded for providing high quality goods to a known market.

Constraints to production

Low yields

Most farmers in Uganda are subsistence-oriented and produce potatoes using low risk systems with no inputs that provide yields of 4–7 t/ha. Whilst costs are relatively low, the produce is not highly competitive on a unit basis.

Interventions

- Improve the seed supply system in terms of tissue culture facilities for prebasic seed.
- Improve facilities and increase production of basic seed.
- Promote the seed through a widespread demonstration program that shows farmers directly the yield gains that can be made using “clean seed”, fertilizer, and pesticides.
- Provide agribusiness seminars to show income benefits of using inputs.
- Improve access to credit so that farmers’ associations can purchase inputs and repay at harvest.

Product quality

Most farmers pay little attention to product quality. Maintaining quality is critical at harvest and although dehaulming is widely practiced, more attention needs to be given to avoid

Table 3. Characteristics of potato varieties released/grown in Uganda.

Common name/year of first release	Tuber size	Skin color	Flesh color	Tuber shape	Vegetative cycle (days)	Seed dormancy (weeks)	Resistance/tolerance		Storability
							LB	BW	
Uganda 11 (1973) (<i>Rukutu</i>)	Large	Light red	Cream	Oval/round	110-130	11-13	Tolerant	Susceptible	Good
Victoria (1992)	Large	Red	Light yellow	Round	90-110	8-10	Moderately resistant	Tolerant	Good
Kisoro (1992)	Medium large	White	Cream	Oval/long	110-120	10-12	Resistant	Tolerant	Good
Kabale (1992)	Large	Purple white	White	Round	110-125	11-13	Moderately resistant	Susceptible	Excellent
Nakpot 1 (1999)	Large	White	White	Oval/long	80-90	9-12	Resistant	Tolerant	Good
Nakpot 2 (1999)	Medium large	Rose red	Cream	Round	85-100	9-11	Resistant	Tolerant	Good
Nakpot 3 (1999)	Medium	White	White	Round	85-100	9-12	Resistant	Tolerant	Good
Cruza 148 (1982)	Large	Light red	Cream	Oval/round	110-130	4-6	Tolerant	Tolerant	Fair
Sangema (1980)	Medium large	Pink	Yellow	Oval/oblong	90-110	10-12	Tolerant	Susceptible	Good

Source: PRAPACE, (2000).

the damage that accelerates deterioration. Standards need to be developed so that farmers produce for specific premiums within known grades and weights.

Interventions

- Incorporate programs to introduce grades and standards with farmers and traders. This can only be done with strong market linkage programs and national promotion schemes.
- Provide farmers with timely market information to backstop the price differentiation available through graded produce.
- Support extension (national and NGO) to strengthen farmers' associations and increase their knowledge of market dynamics in relation to prices, grades, and standards.

Temperature and water

Potatoes are susceptible to drought, and water restrictions seriously limit yield. The crop is very frost-sensitive but that is not a factor in East Africa.

Interventions

- If farmers in Uganda are to improve yields from 7 t/ha to 30 t/ha, irrigation will be required. Use of valley bottom irrigation could be upgraded to maximize yields and supply market gaps.

Late blight (LB)

This is the most important and damaging potato disease worldwide and in Uganda. In a single night, this fungus can devastate a field planted to a susceptible variety. In highly seasonal production, a combination of avoidance and escape measures is effective. In environments such as Uganda, these are ineffective, and control relies on sprays with fungicides and the use of resistant varieties. NARO with support from CIP and PRAPACE has introduced and is evaluating a large number of resistant varieties, many with desirable processing qualities.

Interventions

- Avoid the promotion of potato growing in areas that are prone to LB.
- Include blight resistant varieties in multiplication programs.
- Increase access of farmers to clean seed.
- Target supplies of new varieties to areas that are less prone to disease.

Bacterial wilt (BW)

This is the second most damaging disease. The disease resides in the soil, can be transmitted by seed potatoes, and is found in other crops including banana. BW can spread in dirt carried from one field to another on shoes, farm implements, or vehicles. It can also be transported in irrigation or other water runoff. BW is pervasive in Ugandan soils. Upland soils are less likely to be infected and the presence of BW is probably the largest single constraint to the

widespread production of potatoes in lowland areas of Uganda. Though CIP continues to breed for BW resistance, there are only low levels of BW tolerance among existing potato varieties. CIP and PRAPACE have worked with NARO to introduce integrated management of BW that emphasizes BW-free seed plot management on the farm.

Interventions

- Include wilt resistant varieties in multiplication programs.
- Increase access of farmers to clean seed, especially through the seed plot technique.
- Target supplies of new varieties to areas that are less prone to disease.

Utilization

The total production of potatoes is utilized in various ways. Typically, 10% are used as seed and about 10% are wasted and the remainder is either consumed domestically or exported. Since there are no significant exports from Uganda, the remaining 80% are consumed domestically. Total consumption, in turn, is divided between the markets for fresh and processed potatoes. In this section we will discuss each of these markets.

Total consumption

The Uganda national household survey gives information about expenditure on various foods. In the survey, expenditure on processed and fresh potatoes is not differentiated. As would be expected, expenditure is highest in the south west production zones and urban areas, especially those in central Uganda (Table 4). This pattern illustrates the use of potatoes as a food security crop in the production zones and as a vegetable in the urban areas with a relatively higher income.

Demand for fresh potatoes

The information in Table 5 illustrates expected future demand for ware potatoes. Given the lack of reliable production and consumption data, these are illustrative estimates only. Future demand is derived using projected population statistics (1991), data from the Uganda integrated household survey (1992–1993), and FAO production data. In these estimates, population is the only growth factor. To simplify the calculation, we assume all other socioeconomic and cultural factors such as price, income, and urbanization rate remain constant. We also assume that potato demand equals supply as there is no external potato trade between Uganda and other countries in the region. This would mean that any impact achieved through the adoption of new technology, improved marketing, or accelerated urbanization would increase demand levels.

According to this simple and conservative projection, by 2015, demand for potatoes will be approximately 850 000–1 000 000 t/year. According to this projection, by 2010, urban demand will outstrip rural demand, and in 2015, the urban potato demand of 500 000 t will almost double rural demand of 347 000 t.

Demand for processed potatoes

As with other developing countries in sub-Saharan Africa, Uganda has a very limited range of products (chips and crisps) processed from potatoes. Potato chips (US French fries) are strips of potato fried in oil and eaten freshly cooked and hot as a snack or part of a meal. Potato crisps are very thin oval slices of potato, fried crisp, packaged, often salted or flavored, eaten cold as a snack or with drinks. The bulk of the crop is sold as ware potatoes and eaten as a boiled vegetable. The advent of the urban take-away (fast-food kiosks) in the early 1990s and the entry of South African fast-food companies, such as Nandos and Steers, in Kampala have increased potato processing into chips.

Table 4. Average monthly household consumption expenditure on potatoes by region in 1995.

Region	Rural			Urban			Total	
	Per household monthly expenditure (Ush)	Total expenditure on major foods (%)	Per household monthly expenditure (Ush)	Total expenditure on major foods (%)	Per household monthly expenditure (Ush)	Total expenditure on major foods (%)	Per household monthly expenditure (Ush)	Total expenditure on major foods (%)
Northern	20	0.1	450	0.5	48	0.1		
Eastern	83	0.2	563	0.6	124	0.2		
Central	513	0.6	946	0.6	633	0.6		
Western	1,250	2.2	858	0.8	1,222	2.0		

Source: Uganda National Household Survey (1994–1995), Ministry of Planning and Economic Development.

Table 5. Estimated urban and rural potato demand from 2000 to 2015.

Year	Estimated urban population ('000)	Estimated rural population ('000)	Estimated urban population growth (2000 = 100%)	Estimated rural population growth (2000 = 100%)	Estimated urban population (2000 = 100%)	Estimated rural population (2000 = 100%)	Estimated urban potato consumption (t)	Estimated rural potato consumption (t)	Total estimated potato demand (t)
2000	3,565	18,646	1	1	206,674	271,326	271,326	271,326	478,000
2005	4,785	20,255	1.34	1.09	277,401	294,739	294,739	294,739	572,140
2010	6,328	22,037	1.78	1.18	366,853	320,670	320,670	320,670	687,523
2015	8,648	23,869	2.43	1.28	501,351	347,328	347,328	347,328	848,678

Source: Own calculations.

We estimate that, by 2015, nearly 50% of the potatoes consumed in urban areas in Uganda will be processed into chips, mostly by street vendors and restaurants. However, once they become accustomed to the food away from home, family members are likely to influence shifts in home preparation from traditional recipes towards these more fashionable foods. At present, the quality of processing into crisps is low, but this is also a market that is being explored by the private sector and is likely to grow when quality meets international standards.

As emphasized in the analysis in Table 5, population growth is the major source of growth for fresh potatoes. However, the market for processed potatoes represents a new and dynamic category. In industrial countries the majority of potatoes are processed. Fast-food restaurants, tourists, and urban consumers are the principal sources of growth for this new market segment.

The preference of youth for this universal food is one of the major reasons that the international market for frozen chips has grown 10-fold during the last 20 years. The spread of fast-food restaurants and the growth of the tourism industry are important sources for introducing chips to local populations. Frozen chips are attractive to this group because of their convenience and consistent quality. Savings on labor and cooking oil are also important factors that can make imported chips compete with locally produced fresh potatoes. In many countries, home consumption of frozen chips is nearly equal to consumption in restaurants.

The value of international trade in frozen chips was US\$150 million in 1980 and grew to over US\$2 billion (thousand million) in 1999 (Fig. 4). After two decades of explosive growth and technical improvement, the industry is in a phase of consolidation and concentration. World capacity is dominated by five leading firms from the USA, Canada, and the Netherlands that have plants dispersed around the world. McCain's, a Canadian firm, is the largest and has production plants on every continent. McCain's entered Africa in 2000 when it purchased the leading South African manufacturer of frozen chips.

McCain's has four production facilities in South Africa and employs 1500 people there. They manage their entire supply chain with their own seed farms, ware producers, transporters, and warehouses in a fully "vertically integrated" system.

Morocco and Egypt are the only other African countries with global production capacity. A Dutch-Egyptian joint venture firm produces for the internal Egyptian market and exports to countries in the Middle East. Industrial ventures are large-scale; plants that require the production from 10 000 ha are normal, whereby production to sales systems are fully integrated.

The major import markets for frozen chips are the USA, Japan, European countries, and China. The American market is served by Canada; the Japanese and Chinese markets are dominated by the USA, and the Netherlands covers 90% of the European market. The Middle Eastern markets are relatively small and are served in order by the USA, the Netherlands, and Egypt. Egypt has preferential trade concessions and a close location that makes it well positioned to strengthen its share in that market.

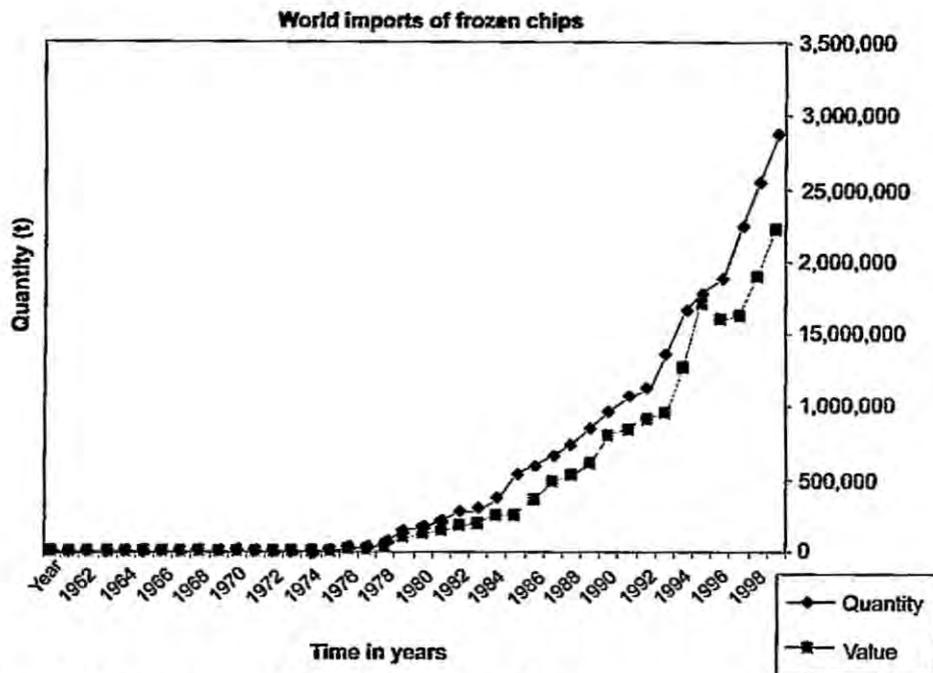


Figure 4. Changes in world imports of frozen chips.
 Source: USDA website, 2002.

The infrastructure that is needed to transport and store frozen foods is an important consideration for investors. Frozen chips typically move around the world in 40-foot containers so a fleet of refrigerated trucks is necessary. Once inside the country, wholesalers and retailers need refrigerated stores to maintain their stock. These facilities are not available in Uganda.

Demand for seed potatoes

Most seed potatoes used in Uganda are saved from the previous crop. This self-supply probably accounts for 70% of seed used in a given cropping season. The majority of the rest are acquired from relations, neighbors, or the local market. Organized seed production occupies a fraction of this market, with the only supplier providing less than 100 t/season. Nevertheless, as outlined in the export strategy, organized seed production is critical to improving the productivity of the sector.

Recognizing this constraint, the Government of Uganda, with national and international collaborators, has continued to support development of the seed sector. At present, there is a single organized seed producing association (UNSPPA) that serves mostly NGO buyers. While the high prices the association charges and the narrowness of their marketing can be criticized, the very presence of an association is a significant advance. The continued presence of the association demonstrates the economic feasibility of the industry and since

it supplies only a tiny percentage of total seed use, the room for expansion is large. See Annex 4a and 4b for details of the association's members, production, and costs. The first focus of expansion should be in the domestic market. Improved marketing of the benefits of using quality seed is probably the way to remove a major impediment to farmers deciding whether to invest in this higher-cost input.

Developing this sector, therefore, requires not only the infrastructure that is outlined in the export strategy, but also a well coordinated marketing strategy with a promotional phase that is backed up with credit, so that farmers can access the new varieties. The complicating factor with the sales of new seed is that, as with maize, the most cost-effective results are obtained only when the clean seed is used in conjunction with other inputs, such as fertilizer and pesticides. To capitalize on these technologies, farmers need to manage the quality of the crop at harvest and during the postharvest phase to maximize their returns.

In order to promote the use of the new seed, the national potato program should devise a targeted demonstration program that shows farmers the benefits of having inputs in contrast with the results of not having them. A similar scheme is being implemented in Rwanda.

After the seed industry has gained experience in serving the domestic market and increased its capacity, the practicality of serving an export market becomes viable. The macropolicy setting for trade in seed is improving in the region with the initiative led by Eastern and Central African Program for Agricultural Policy Analysis (ECAPAPA) on the harmonization of phytosanitary regulations. Within five years, the movement of seed within the region could be substantially improved.

Potato production costs

Production of seed and ware potatoes requires the same basic inputs and labor. However, for farmers to produce clean certified seed, they must use seed from a recognized source. Seed for ware potato production can be grown from any source. Potential yield is highly dependent on seed quality and, ideally, farmers would plant new, clean seed potatoes each year. Our field survey found that most farmers blamed low yields on poor quality seed. Farmers said they use local seed retained from their harvests or bought from neighbors. The costs incurred and margins received by an average farmer in Mbale and Kapchorwa for the cultivation of one acre of potatoes using minimum inputs are shown in Table 6.

Most potato farmers do not use fertilizers or pesticides. The combination of no fertilizers, no pesticides, no certified seed, and land hiring is the most common agricultural practice of peasant farmers in Uganda. Most farmers do not keep records and therefore the costs of production presented in Table 6 illustrate the probable costs of cultivating 1 acre of potatoes. From a total investment of Ush 365 000, the likely yield, given favorable weather conditions, is 100–120 bags. From this transaction farmers earn approximately Ush 35 000, (US\$20 × Ush 1700) which is only 8.75% of the total sales, with a portion of the production being retained for household consumption. For sensitivity analysis, see Annex 5.

Note that most labor comes from family sources; it is not wage labor and does not represent a cash outlay by the farmer. Our estimates, however, put a value on that labor

Table 6. Ware potato production costs (Ush) in Kapchorwa district, Uganda, 2001.

Item	Unit price	Total cost
Inputs		
Land rental (1 acre)	25,000	25,000
Seeds 15 bags (1 bag~100 kg)	10,000	150,000
Chemicals (Ambush and Diathane)		30,000
Fertilizer (NPK) 1 bag (optional)	35,000	35,000
Labor		
Plowing (twice)	15,000	30,000
Ridging and planting	15,000	15,000
Second ridging	15,000	15,000
Weeding (twice)	15,000	30,000
Fertilizer application (optional)	10,000	10,000
Spraying	5,000	5,000
Harvesting	20,000	20,000
Total costs		365,000
Revenue return		
Yield 1 acre = 11 t (110 bags × 100 kg)		
Farm-gate price/bag = Ush 4,000		
Gross revenue		400,000
Net margin		35,000

Source: Own calculations.

and the difference between what is paid to wage labor and not paid to family labor represents additional income to the family. This illustrates one of the benefits of potato production: its capacity for rural labor generation. Probably more than any other field crop, potatoes generate rural labor opportunities, in this case, the equivalent of Ush 125 000 worth of labor/acre/season.

In 2000, an estimated 100 000 acres were planted to potatoes in Uganda. Multiply this by the value of labor/acre from the table and potato production creates Ush 12.5 thousand million in labor value. There are few rural development programs that can transfer that amount of income to the rural sector.

Ware potato marketing in Uganda

Description of trading and the marketing chain

Constrained by the perishable nature of the produce and the limited on-farm storage facilities, farmers usually do not harvest potatoes until they have identified a buyer. Travelling traders/brokers also rarely buy from farmers before contacting their buyers in Kampala. This caution aims to reduce the postharvest losses that are associated with fresh produce. There is almost no off-farm storage, so rapid movement from the farm gate to final consumer characterizes potato marketing.

Farmers

They are the first link in the potato marketing chain. Farmers are both producers and consumers. A sizeable portion of output is consumed by the households from their own production and by purchasing from neighbors and village markets. At the time of sale, the farmer or the local trader/broker makes the initial contact. After striking a deal on price, the farmer and village trader/broker agree on harvest date, sorting, and packaging. Generally, the farmer harvests the potatoes while the village trader/broker provides the packing bags and does the sorting and packing. Individuals or farmer groups rarely transport and wholesale their own produce at urban markets. Most often, produce is sold at the farm gate on a cash basis. Besides selling to village assemblers and brokers, farmers also sell their potatoes by the roadside, take them to the weekly village markets, or sell them to a village retailer.

Village traders/assemblers

Village traders know the farmers in their village and surrounding areas and make it their business to know the farmers who are ready to harvest. Village traders are in contact with transporters, wholesale buyers, and providers of financial services. After identifying farmers willing to sell and agreeing a price, village traders contact wholesale buyers using mobile telephones. The wholesaler who urgently requires supplies can also initiate trade. When a wholesaler requires potatoes, he will call his contact (village trader), agree on a price and other marketing arrangements, and the village trader will assemble the product. To accelerate the process, village traders are given cash advances from wholesalers, in which case they regard themselves at times as brokers. Village traders/assemblers also sell to travelling traders from Kampala and to contacts in other towns. Figure 5 illustrates the typical potato trading chain.

Brokers

Brokers are prominent participants in the potato marketing chain. In rural areas, brokers are the contact for travelling traders and wholesale buyers to farmers, as well as the key link between farmers and traders. Brokering is a lucrative activity and some successful village traders and wholesalers become brokers. Brokers are paid immediately on a bag basis for their services. The amount ranges from Ush 500 to 1000/bag, depending on the quantity

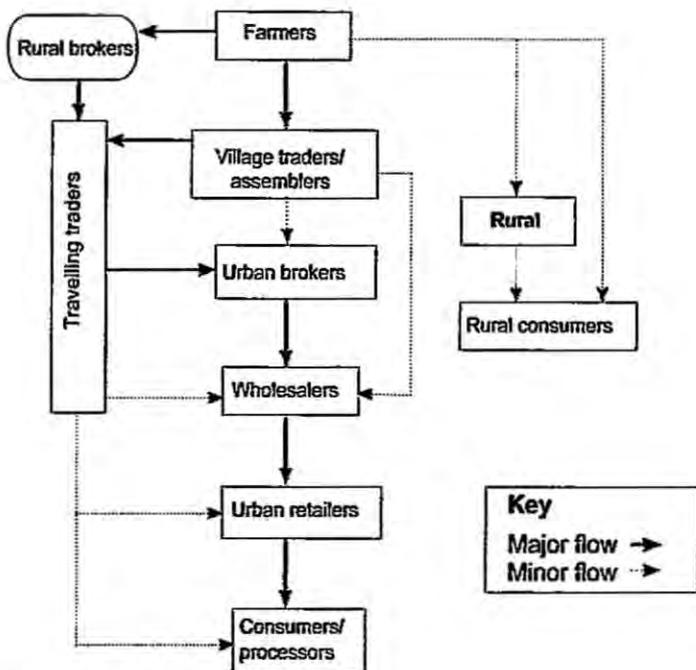


Figure 5. The ware potato trading chain.

and the urgency with which the consignment is required. Apart from rural brokers who link farmers with the travelling traders, there are also brokers in most urban centers who link travelling traders to wholesalers and urban retailers. In Kampala markets, we found that, after agreeing a price with a travelling trader, brokers were free to sell at whatever price they could negotiate with the buyers. Thus the commission that the brokers receive varied from Ush 500 to 2000/bag, depending on market conditions. Brokers are an organized and influential group in the market (especially Owino market) and few travelling and village traders can directly sell to wholesalers and urban retailers, as shown in Figure 5 by dotted lines (minor flow).

In many respects the broker commands a position that plays a vital role, but also, due to the nature of this position, restricts others from entering the market. More competition in this area would probably make for a more open market.

Travelling traders

These are traders who either own trucks or hire them for buying potatoes from farmers or village traders and then transport and sell to wholesalers and urban retailers in other district markets. These traders supply most of the potatoes to wholesalers and retailers through brokers. Travelling traders with fresh potatoes (high quality) typically raise their

prices relative to those prevailing in the market. However, when their stocks do not sell as quickly as they anticipate and quality starts to deteriorate, these traders reduce the price accordingly. Travelling traders will sell at clearance prices to avoid further overheads such as accommodation costs, overnight parking fees, product losses, and transport surcharges from truck owners. Travelling traders sometimes also sell at a loss, especially when there is an excess supply on the market coupled with other substitute foodstuffs such as cooking bananas, sweetpotato, and cassava.

Wholesalers

Major potato wholesalers are largely found in the Owino and Nakawa markets in Kampala and Mbale. In other towns, traders double as wholesale and retail traders because of the lower volumes. More often, wholesalers get their supplies from travelling traders. Wholesalers rarely buy directly from farmers. Traders know the varieties with the right qualities for making good chips and crisps and that are most in demand by restaurants. A popular variety, Uganda II (*Rutuku*), is preferred for chips and crisps and is sold at a premium price of 7–13% over other varieties.

Retailers

Potato retailers range from supermarkets to village roadside sellers. In urban areas, market retailers buy 1–5 bags from the wholesalers and then sell the potatoes in heaps of various sizes and grades for amounts ranging from Ush100 to 2000/heap. This wide range aims to cater for the needs of all income groups, i.e., those buying two or three small potatoes to those buying larger heaps of several kg of higher quality tubers. A heap sold at Ush1000 weighs an average of 3 kg. Retailers sort and grade potatoes according to variety and degree of freshness. Unfortunately, grades vary by batches and farmers cannot rely on them. Recently, some supermarkets such as Shoprite have started selling potatoes in 5 kg packages of high-grade product, and this practice is a real shift towards establishing a standard. In rural areas, potatoes are sold on the roadside by the heap or tin. A heap with an average weight of 10 kg sells for approximately Ush 2000. The area of retail grades and standards needs considerable attention, if effective market signals are to be developed for farmers.

Processors

Hotels, restaurants and take-away (fast-food) outlets are the main business enterprises that process potatoes into chips. In urban areas, over 50% of potatoes may be consumed as chips (per communication Owino Traders). According to the traders, most of their bulk buyers are processors from the fast-food and restaurant sectors. Minimum inputs needed to process chips are fresh potatoes, cooking oil, cooking fuel, and a pan. These inputs are locally available. Despite the abundance of good quality potatoes available in Uganda, the South African-based fast-food restaurants, such as Nandos and Steers, import processed potatoes (frozen chips) from South Africa. This would appear to be a valuable niche market if Ugandan growers could produce the particular varieties required to supply these outlets. There are some small-scale food processors that make crisps from potatoes. Crisps are not

yet widely eaten. Students and young people in urban areas are the principal consumers, which means that the market is limited now but is set to grow as this age group matures and incomes increase.

Given that 50% of urban consumption is processed, it is projected that by 2015 up to 250 000 t of potatoes will be consumed as processed products. For industrial processors, this market size may prove to be highly lucrative if local products can compete with overseas frozen products from Egypt or South Africa. In Peru, the epicenter of the potato, one of the major local processors preferred to import frozen chips rather than process local potatoes because they were a better product and the processor made savings through lower costs for labor and cooking oil. Therefore, quality is again a key to market share.

Consumption and prices

Across the country, Ugandans spend five times more of their monthly consumption budget on cooking bananas than on potatoes. Cooking bananas, the staple of the Lake zone, rank as the number one food staple in central and some parts of eastern and western districts. Highest monthly household expenditure goes to cooking bananas, sweetpotato, cassava, and potatoes.

The data in Figure 6 show the nominal retail price of potatoes in selected markets in Uganda from September 1988 to September 2000. As with other perishable horticultural crops, this graph shows a typical instability of potato market prices associated with seasonal

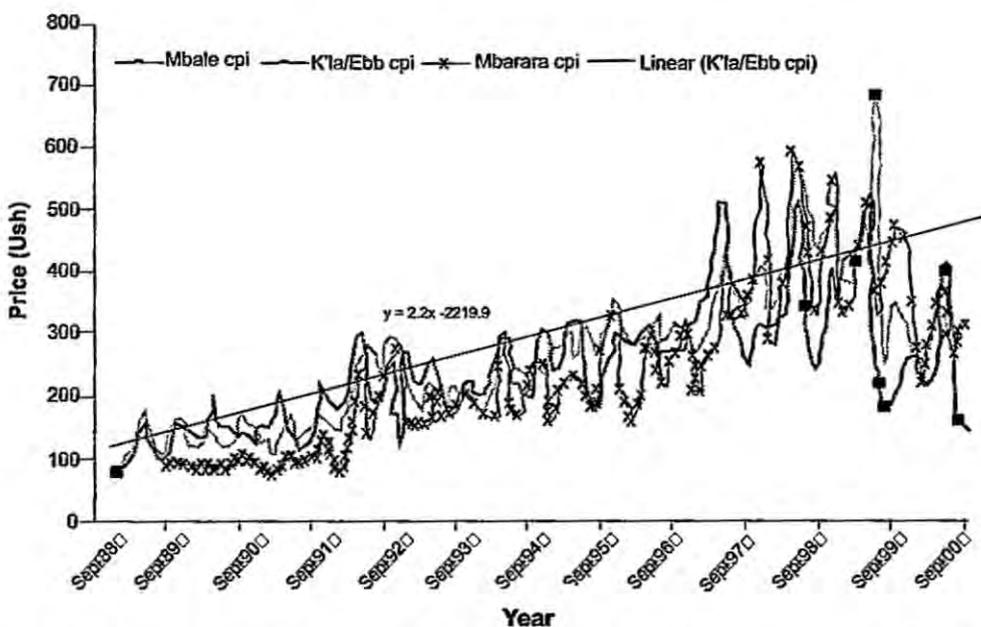


Figure 6. Trend of monthly nominal retail price of potatoes in selected district urban markets.

Source: Uganda Bureau of Statistics; Ministry of Finance and Economic Development.

supply that meets a steady demand. The linear trend shows that, over time, potato prices have more than doubled in the last 10 years in direct relation to the macroeconomic conditions (inflation, exchange rate instability, supply shocks, etc.) prevailing in the country.

The deflated retail prices of potatoes in Kampala, Mbale, Masaka, and Mbarara, indicate that real prices have been stable (Fig. 7). The most likely reason why real prices have remained almost constant over the long run is that, while demand for potatoes has increased, supply has matched growth. In Uganda, ware potato production is no longer a monopoly of the highland regions of the Kigezi districts. *Victoria*, a versatile potato variety with a short maturity period, can be grown in virtually all parts of Uganda with adequate rainfall.

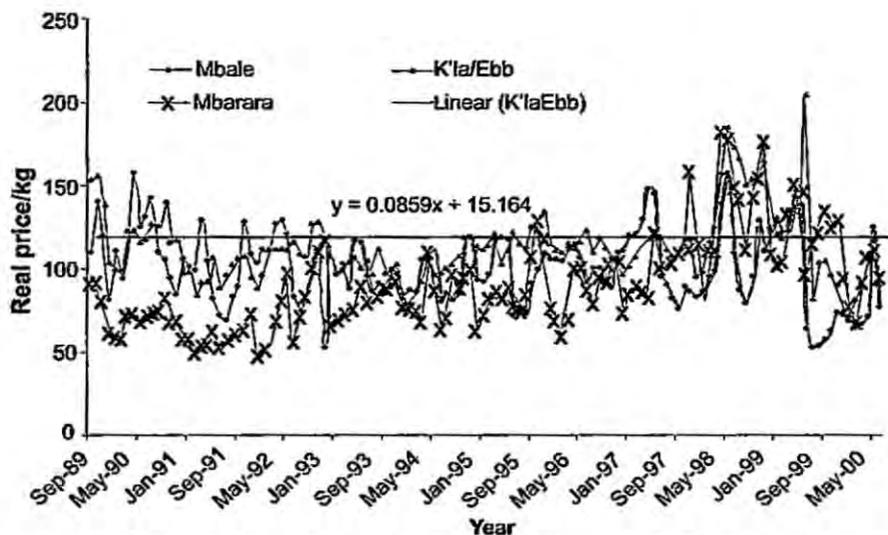


Figure 7. Trend of monthly real retail price of potatoes in select district urban markets: (base year: Sept 1989 = 100).

Source: Uganda Bureau of Statistics; Ministry of Finance and Economic Development.

Ware storage

Price instability is a constant problem for producers and a source of much complaint by government authorities. Ware potato storage is often suggested as a solution to this problem. Ware storage is typically used in places with strongly seasonal production and very high or very low off-season temperatures. North America, Europe, India, and Egypt are regions where storage is widely used. Where potatoes are produced in tropical highland conditions, such as those found in East Africa, the Andes, or southern China, the use of ware storage is limited. Different crop production calendars from different production zones ensure that fresh produce can be found in most markets during most of the year. A fresh potato is superior to a stored one and consumers strongly prefer the former.

During the 1970s, Venezuela, Colombia, Ecuador, and Peru all experimented with government-run ware potato storage services with the objective of reducing the size of the price cycle. In all cases, the investments were failures and today, governments in the region do not attempt to manage ware potato prices. The storage schemes failed because farmers did not want to put their potatoes into store. For a ware storage system to be successful, the farmer must be able to reliably sell his stored potatoes at a price above the price at harvest time plus the cost of storage. This was not possible in the Andes and would not be possible in East Africa.

In East Africa, there is limited potential for ambient temperature storage, especially in areas near to the urban markets. Refrigerated stores require reliable sources of electricity and are expensive to build and operate. This further reduces the feasibility of large-scale ware storage.

Marketing costs and margins

The data in Table 7 show the costs and margins derived from the survey of various participants along the potato marketing chain, as found in August 2001. The tables present the costs and returns on potato trading between western Uganda (Kabale, Kisoro, Mbarara, Rakai) and Kampala.

At the farm gate, the "average farmer" in Kabale sells potatoes at Ush 8000/100 kg bag. The farm-gate spread price was between Ush 5000 and 15 000, depending on the variety. This wide range reflects either the lack of accurate and timely market information available to farmers or their inability to negotiate effectively with traders, and many farmers were aware that they did not negotiate as an association and this weakened their position. As indicated in the potato marketing chain in Figure 5, travelling traders are the main buyers of potatoes, through a third party, the rural broker. To ensure quality and minimum postharvest losses, travelling traders provide packing bags, pay labor to sort and pack, and incur various other costs, as indicated in Table 7.

Travelling traders are exposed to many risks as they move food from rural areas to urban centers. In Uganda, potatoes are grown in highland areas which have the worst road networks. While in transit, traders may find that a section of the road has been washed away or their truck may break down. In such cases, travelling traders may face 50–100% loss of the consignment. In business, the higher the risk, the higher the return, and this is particularly true in potato trading where the travelling trader enjoys a net margin of over 35%.

While wholesalers seem to earn a lower net margin of Ush 2393 (9.5%)/bag of potatoes and retailers get an average net margin of Ush 3700 (12.3%), they usually have a higher turnover than retailers. A wholesaler may sell between 200 and 400 bags of potatoes/month, giving him a net income ranging from Ush 400 000 to 800 000/month, whereas the retailer may sell 20–40 bags giving him a monthly net income range between Ush 70 000 and 150 000 only. Brokers who have an opportunity to handle five × 10 t lorries in a month, can attain a monthly income of between Ush 250 000 and 500 000.

Table 7. Potato marketing costs and margins.

	Ush/100 kg bag	% of selling price
Farmer		
Farm-gate price	8,000	
Travelling trader		
Purchase price	8,000	
Selling price	22,000	
Gross margin	14,000	63.6
Costs		
Commission (Rural broker)	1,000	4.5
Packing bags	500	
Sisal rope for sewing top	83	
Grass for packing	33	
Sorting, packing, and sewing labor cost	300	
Loading	200	
Subcounty tax levy	200	
Transport	5,000	
Total cost before Kampala market	7,316	
In Kampala markets		
Market fee	500	
Offloading fee	200	
Commission (urban broker)	1,000	4.5
Costs in Kampala market	1,700	
Total costs	9,016	
Net margin	4,984	35.6
Wholesaler		
Purchase price	22,000	
Selling price	25,000	
Gross margin	3,000	12.0
Costs		
Market stall rent	14	
Miscellaneous overhead costs	100	
Postharvest loss	500	
Total costs	614	
Net margin	2,386	9.5
Retailer (Owino market)		
Purchase price	25,000	
Selling price	30,000	
Gross margin	5,000	16.7
Costs		
Market stall rent	200	
Miscellaneous labor	300	
Miscellaneous overhead costs	100	
Postharvest loss	700	
Total costs	1,300	
Net margin	3,700	12.3

Source: Own calculations.

Ware potato imports/exports

Interviews held with traders and government revenue officials along the Uganda–Rwanda and Uganda–Kenya borders revealed a limited trade in potatoes between Uganda and her neighbors.

At Katuna (Uganda–Rwanda border), a prominent potato trader explained the system of marketing Rwandan potatoes to Kampala. When there is a scarcity in Kabale (September–November) amidst high demand from Kampala, traders from Kabale and Kisoro exploit the situation by importing potatoes from Rwanda, repacking them in Kabale, and reselling them as potatoes from Kabale. The traders say they buy potatoes from assembly centers in Ruhengeri owned by a cooperative organization. The traders repack the potatoes by mixing a large percentage of Rwanda potatoes with a smaller amount from Kabale. This is done to persuade travelling traders from Kampala that the whole consignment is from Kabale. Sometimes Kabale brokers who are advanced credit by their trading partners in Kampala mix Kabale potatoes with those from Rwanda. This phenomenon of potato repacking is influenced by the quality of Kabale potatoes. It is generally recognized that Rwandan potatoes are of a lower quality than Ugandan potatoes. Rwandan potatoes have a high water content as most farmers do not practise dehauling because this reduces weight. However, potatoes with a high water content have a short shelf life. Rwandan potatoes are saleable for only 3–5 days and are therefore treated as a fresh vegetable on the market.

According to reports from Owino markets, Rwanda did attempt to send a shipment of potato to the markets in Kampala, but due to their poor quality, the sale price was very low and this was not repeated.

Other than at Katuna border, traders revealed that potato trade between Uganda and Rwanda exists informally along other smaller border crossings in Kabale and Kisoro, such as Cyanika. In addition, some traders occasionally import potatoes from Eastern Congo (Masisi). A review of the literature suggests there is no cross-border trade in potatoes between Uganda and Kenya. The Technoserve/University of Nairobi Technical report of 1997 on cross-border trade between Uganda and Kenya makes no mention of potato trade. Traders from Kapchorwa who regularly sell maize grain into Kenya said they had never attempted to sell potatoes from Kapchorwa to Kenya. Also no traders from Mbale, Tororo, Busia, and Malaba districts that border Kenya claimed to have imported or exported potatoes between Uganda and Kenya. The potato production map of Kenya shows a major area for potato production on the slopes of Mount Elgon on the Kenyan side. This suggests that all the Kenyan districts bordering Uganda have adequate potato supplies within Kenya.

Constraints to marketing

There are a number of problems in the marketing of potatoes which means that producers obtain low prices and consumers face high prices.

- Lack of associations or fora at which producers, traders, and processors can meet to explore new trading opportunities and marketing channels.
- General lack of understanding of market opportunities.

- Lack of standards/premiums that would encourage more commercial farming.
- Highly seasonal supply, which forces down prices, combined with the perishable nature of the crop.
- Lack of associations that could foster collective purchases of inputs and negotiate higher sales prices. Greater cooperation amongst farmers could also be used to leverage credit and act as a conduit for spreading knowledge.
- Lack of market information or an inability of farmers to be able to benefit from knowing market prices, due to lack of associations.
- Collusion amongst traders which drives down farm-gate prices and yet also retains high urban market prices. At the retail level, many traders collude to maintain prices to protect themselves from rapid price fluctuations.
- Lack of processing technologies and industries to segment the market more effectively.

Opportunities

- Strengthen state-financed research, development, and extension agencies within a well-defined market orientation. The R&D should have access to or build capacity to collect information and analyze market trends, and provide farmers with advice based on market conditions. This may mean that R&D organizations have to hire a range of different types of skills to improve on their ability to respond to and advise others on market conditions. *The current export strategy has no marketing component and a strong case needs to be developed that investment in potatoes will supply an identified market.*
- Invest in training or facilities to enable farmers to improve the quality of crop products, in terms of information and training in grading, sorting and weighing, and the reasons for meeting recognized standards.
- Invest in or provide credit to promote the use of inputs.
- Promote collectivization at the rural level to gain economies of scale through integration of labor and development for the capacity to benefit from lower input prices through joint procurement of agricultural inputs and collective sales of bulked agricultural products. This will also assist with increased sales prices to farmers and reduce transport costs.
- Provide market information related to local, national, and regional market opportunities, through local radio stations.
- Train farmer groups in methods to undertake or understand information based on or derived from market studies.
- Develop stringent guidelines for market operation and encourage the development of more transparent, less collusive behavior in the marketplace, through the provision of monitoring services on marketing practices against noncompetitive activities.
- Work with donors and the private sector to investigate the possibilities of investing in value-added processing. This will require support from donors in terms of technical assistance and credit guarantees.
- Promote the sorting of varieties at the market.

The way forward

Uganda has a long-term comparative advantage for the production of both seed and ware potatoes based on its climatic conditions in highland areas. However, the production at present is geared entirely towards domestic markets, primarily for food security, and secondly to supply the growing urban demand. Although, thanks to its favorable production zones and low cost of labor, Uganda has a comparative advantage, its competitive advantage in the regional and global marketplace is both untested and at this time limited. Consequently, prior to any attempts to enter external markets, it is more practical to consider the current plan as a means to strengthen the domestic market and put production on a more competitive/market-oriented footing. Developing a more competitive domestic market is a highly desirable goal, given the importance of potatoes as a food security crop and the fact that regional trade is likely to increase within the new frameworks of the East African Community, COMESA, and the World Trade Organization.

The potato sector in Uganda is expanding, responding to growth in demand from urban areas. Potatoes can yield over 30 t/ha in Ugandan conditions, but present yields are only from 4 to 7 t/ha, thus the crop has considerable room for technical improvement. The crop responds well to irrigation and fertilization. The major pests and diseases are controllable with good seed and crop management. Integrated pest management (IPM) technology for the major pests and diseases exists to minimize the use of agrichemicals.

It is a crop ideally suited for smallholder farmers on sloping lands where mechanization of production is difficult. The crop requires many labor days so as a source of rural employment it probably cannot be surpassed on a per hectare basis.

In production areas, the potato is a food security crop. In nonproduction areas, it is a vegetable that is increasing in popularity and importance. Population growth will drive increases in demand for fresh potatoes. Income growth and the expansion of supermarkets and fast-food restaurants will contribute to the creation of an industrial processing sector that will lead growth of this new market segment.

Whilst the government's plans are sound in their desire to improve production, the proposal might be more sustainable if it were to consider developing the sector in a more market-oriented manner. The following steps may be helpful in incorporating a marketing component into the present strategy.

Step 1. Improving the seed supply sector (2002–2004)

The strategy being proposed by the government will initially focus on the development of an improved seed sector; this is essential. All the countries in the region have facilities for supply of prebasic and basic seed, except Uganda, and therefore this aspect is of highest priority.

- Develop tissue culture facilities for importation and holding of key varieties and for rapid multiplication of plantlets.

- Improve or construct screen houses for minituber multiplication leading to the production of prebasic and basic seed stocks.
- Improve production and bulking rates for basic seeds through outgrower systems that are linked to a monitored certification scheme.
- Construct storage facilities for holding seed stock
- Develop credit facilities or loan guarantees with donors to enable NGOs and farmer associations to purchase seed, fertilizer, and pesticides.
- Use extension via demonstration plots to promote and support the process through an orchestrated media campaign.

Potential actors in Step 1

This activity should be led by NARO as they have trained staff, working in collaboration with PRAPACE, CIP, and local NGOs, and extension agents from the National Agricultural Advisory and Development Service (NAADS) and MAAIF. The Uganda National Seed Potato Producers Association (UNSPPA) should play a key role in developing the basic seed in collaboration with NARO.

Prebasic seed development of tissue culture plantlets	NARO, CIP, PRAPACE
Production of basic seed	NARO, UNSPPA, PRAPACE
Bulking of basic seed through outgrowers	UNSPPA, AFRICARE, PRAPACE, CARE, AHI, farmers' associations
Storage facilities	Market trader associations
Rural loan guarantee schemes	Uganda microfinance consortia, Centenary Bank, Agricultural Cooperative Development International (ACDI) risk fund, World Bank
Promotion, demonstration plots	NARO, local NGOs, farmers' associations

Step 2. Defining the market (2002–2005)

- Statistics on production levels of potato in Uganda need to be improved.
- A number of studies need to be done to define the market segments clearly. For example, if there are any export-quality markets available, a business plan is required to evaluate the accessibility of these markets. It may also be possible to develop a niche sector for frozen chips to supply the local market. If successful, fast-food chains such as Nandos and up-market retailers such as Shoprite may be amenable to the process. This would be import substitution rather than an export market, but would achieve the same result. Studies need to evaluate

demand in the following segments: prebasic and basic seed potatoes, ware potatoes (low quality, premium, and export quality), frozen chips, crisps, and other snacks.

- Grades and standards have to be developed with farmers' associations, traders, and retailers. This work will need to be done through a market-led approach to define what share of the market is prepared to pay a premium and how this can be integrated into the marketing system. Traders already sell a large percentage of their product to processors and this market area should be targeted for higher quality, graded sales.
- As part of this process of strengthening linkages along the market chain, development agencies should provide marketing specialists to guide this process and assist the players to test new ideas and meet to discuss new proposals in a constructive manner.
- Donors, cooperatives, and government should establish partnerships to promote and implement the development of the marketing strategy.

Potential actors in Step 2

This activity should be led by agencies that are qualified in market research in Uganda such as Investment in Developing Export Agriculture (IDEA) USAID Business Center, Competitive Private Enterprise and Trade Expansion Project (COMPETE), FOODNET, CIP, CIAT, and local market research agencies. However, the work needs to be done in close collaboration with the private sector and therefore linkages need to be made for the specific aspects of the market segments.

Production statistics	FAO, MAAIF, Natural Resources Institute (NRI –UK), PRAPACE, CIP.
Market studies	FOODNET, PRAPACE, CIP, IDEA, CIAT, consultants.
Market information	NAADS, FOODNET, COMPETE, local FM radios, Mobile Telephone Network (MTN), NARO, MAAIF.
Defining market segments and grades and standards	Shoprite, major market traders, Chambers of Commerce, transporters' associations, farmers' associations, Private Sector Foundation (PSF).
Supply chain support	PSE, FOODNET, CIAT, NGOs, private sector partners in the chain including farmers' associations, input suppliers, traders, and retailers.
Promotional strategy	Media consultants, FM radio, NAADS.

Step 3. Making production more competitive (2002–2010)

- Farm-level demonstrations should be developed in partnership with extension, NGOs, and NAADS to show the benefits of clean seed, fertilizer, and pesticides.
- Agribusiness information needs to support the demonstrations such that farmers can be shown the economic benefits and also to link premium products to best market opportunities. A radio-based promotional campaign would be useful in reinforcing the benefits of input-based farming.
- The local capacity should be developed to provide market information and routine market studies to measure changes in the market conditions.
- The development of farmer associations should be encouraged so that credit and the use of market information can be linked to associations.

Potential actors in Step 3

Demonstrations to promote inputs

NARO, NAADS, UNSPPA, IDEA, NGOs, farmers' associations.

Agribusiness information

CIAT, IDEA, COMPETE, Support for Private Enterprise Expansion and Development (SPEED), FOODNET, Community Enterprise Development Organization (CEDO).

Market information

FOODNET, AHI, NGOs involved with telecenters, FM radios, Farm Implements and Tools (FIT, an NGO) Uganda business news.

Strengthening of farmers' associations

Cooperative League of the United States of America (CLUSA), CEDO, NAADS, local government, Plan for the Modernization of Agriculture (PMA, government policy framework document), farmers' associations

Step 4. Developing the markets (2005–2015)

- Increase support to most competitive areas of production, based on results from uptake of new technologies.
- Support the linkage of identified markets to the most successful/innovative groups, i.e., those that have adopted the higher input farming systems and are able to integrate improved management and grading into their systems.
- Donors to provide interested processors with incentives, to develop local processing capacity, in terms of grants, loan guarantees, and technical assistance for business development.

Potential actors in Step 4

Support to most competitive areas

NAADS, Private Sector Foundation (PSF), Centenary Bank, ACDI risk fund, IDEA, FOODNET, SPEED, Uganda microfinance consortia.

Market linkage

IDEA, CIAT, FOODNET, High end retailers such as Shoprite.

Support to processors

PSE, Centenary Bank, ACDI risk fund, IDEA, FOODNET, SPEED, Uganda microfinance consortia.

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Annex 1. Production of potatoes (t) by district.

District	1992	1993	1994	1995	1996	1997	1998	1999	2000
Apac	652	779	896	979	774	877	935	1,094	1,164
Arua	3,061	3,555	4,203	4,591	3,632	4,112	4,386	5,129	5,460
Bundibugya	2,703	3,227	3,711	4,054	3,207	3,630	3,872	4,527	4,820
Bushenyi	1,289	1,539	1,770	1,934	1,530	1,732	1,847	2,160	2,300
Gulu	-	-	-	-	-	-	-	-	-
Hoima	2,683	3,204	3,685	4,025	3,184	3,605	3,845	4,496	4,787
Iganga	5,712	6,820	7,843	8,568	6,777	7,672	8,183	9,569	10,187
Jinja	5,610	6,698	7,703	8,415	6,656	7,536	8,038	9,399	10,006
Kabale	100,681	120,216	138,248	151,020	119,464	135,242	144,258	168,677	179,571
Kabarobe	5,238	6,254	7,192	7,856	6,215	7,036	7,505	8,775	9,342
Kalangala	122	146	168	184	145	164	175	205	218
Kampala	-	-	-	-	-	-	-	-	-
Kamuli	6,816	8,138	9,359	10,224	8,087	9,155	9,765	11,418	12,156
Kapchorwa	6,200	7,403	8,513	9,299	7,356	8,328	8,883	10,387	11,058
Kasese	5,694	6,799	7,819	8,541	6,757	7,649	8,159	9,540	10,156
Kibaale	2,273	2,714	3,121	3,409	2,697	3,053	3,257	3,808	4,054
Kiboga	1,637	1,955	2,248	2,456	1,943	2,199	2,346	2,743	2,920
Kisoro	27,543	32,887	37,820	41,314	32,681	36,998	39,465	46,145	49,125
Kitgum	96	115	132	144	114	129	138	161	171
Kotido	-	-	-	-	-	-	-	-	-
Kumi	5,785	6,907	7,943	8,677	6,864	7,770	8,288	9,691	10,317
Lira	7,398	8,833	10,158	11,096	8,778	9,937	10,599	12,394	13,194
Luwero	9,675	11,552	13,285	14,512	11,480	12,996	13,862	16,209	17,256
Masaka	8,841	10,556	12,139	13,260	10,490	11,875	12,667	14,811	15,767
Masindi	2,675	3,194	3,673	4,012	3,174	3,593	3,833	4,481	4,771
Mbale	12,125	14,478	16,650	18,188	14,388	16,288	17,374	20,315	21,627
Mbarara	6,050	7,224	8,308	9,076	7,179	8,127	8,669	10,136	10,791
Moroto	-	-	-	-	-	-	-	-	-
Moyo	211	252	290	317	251	284	303	354	377
Mpigi	2,539	3,032	3,487	3,809	3,013	3,411	3,638	4,254	4,529
Mubende	2,455	2,931	3,371	3,682	2,913	3,298	3,518	4,113	4,379
Mukono	1,478	1,765	2,030	2,218	1,754	1,986	2,118	2,477	2,637
Nebbi	3,037	3,626	4,170	4,555	3,603	4,079	4,351	5,087	5,416
Ntungamo	-	-	-	-	-	-	-	-	-
Pallisa	2,191	2,613	3,005	3,283	2,597	2,940	3,136	3,667	3,904
Rakai	3,460	4,131	4,751	5,190	4,105	4,648	4,958	5,797	6,172
Rukungiri	8,457	10,098	11,613	12,686	10,035	11,360	12,117	14,168	15,084
Soroti	6,453	7,705	8,861	9,680	7,657	8,668	9,246	10,811	11,509
Tororo	7,161	8,554	9,837	10,746	8,500	9,623	10,265	12,002	12,777
Total	268,001	320,000	368,002	402,000	318,000	360,000	384,000	449,000	478,000

Production ('000t) of potatoes in Uganda 1980-1992.

Year	1980	1981	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Production ('t)	166	175	209	132	168	98	185	190	248	224	254	268

Source data: Ministry of Agriculture, Animal Industries, and Fisheries.

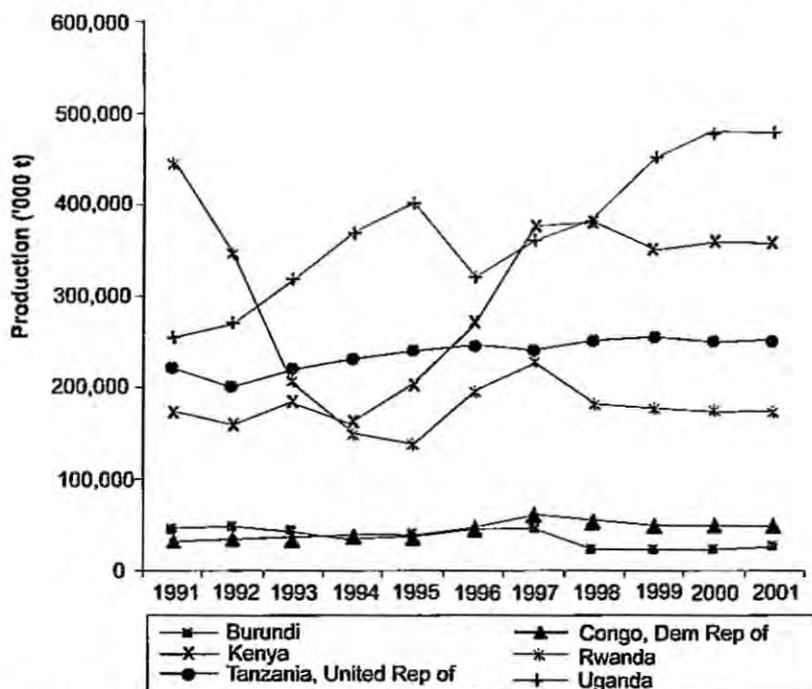
Annex 2. Potato production statistics in ten selected districts of Uganda, 2000 and 2001.

Year	2000		2001*	
Districts	Ha	T	Ha	T
Kapchorwa	0	0	2,500	27,500
Mbale	840	10,080	1,050	12,600
Sironko	755	8,305	700	5,250
Mubende	0	0	4,800	28,800
Masaka	192	1,344	200	1,300
Mbarara	0	0	10,710	77,112
Bushenyi	0	0	800	5,600
Kisoro	24,930	448,740	25,160	452,750
Kabale	32,500	603,355	33,750	615,375
Nebbi	660	7,720	725	7,910
Total	59,877	1,079,544	80,395	1,234,197

*Annual production (t) is estimated from last year's mean yield as most districts are yet to harvest the second season crop.

Source: Wagoire et al. (2001).

Annex 3. Potato production in East and Central Africa.



Source: FAOSTAT.

Annex 4a. Analysis of production cost for UNSPPA members in 2000b season.

Names	Bags planted	Bags harvested	Damaged bags	Net harvest	Multiplication rate	Capital Input (Ush)	Production cost per bag (Ush)	Net return (%)
Belnamaryo	10	70	1.5	69	7.0	157	11,514	121.8
Bitarabeho, F.	10	66	3	63	6.6	148.6	11,791	36.7
Karibushe	10	82	4.5	78	8.2	182.2	11,293	128.3
Kemani E.	3	18	0.5	18	6.0	45	11,988	191.9
Khumuro A.	10	66	3	63	6.6	148.6	10,091	110.2
Kikafunda	5	19	1.5	18	2.7	45.7	18,289	28.1
Kislizi	8	48	3	45	6.0	110	12,969	88.0
Mwongyera	12	100	6	94	8.3	220.3	10,520	171.9
Rubereti	6	29	3	26	3.2	67.2	16,414	-46.6
Sentaro	10	68	0	0	6.8	84.8	13,456	-38.8
Tindimubona	14	115	3	112	8.2	252.2	15,196	158.7
Twesigye, V.	3	24	1	23	8.0	59	13,313	87.8
Subtotal	101	705	30.0	755	7.8	1520.6	11,302	96.2

*Each bag weighs 80 kg.

For every bag that was planted, 7.8 bags were harvested (Annex 4a). There was a marked increase to this ratio, which could be probably attributed to better crop management. The mean production per bag was Ush 11,302 with a minimum and maximum break-even point at Ush 10,091. For farmers whose crops were not degraded to ware potatoes, the average marginal net rate ranged between 28.1% and 191.9% (Annex 4a). Average marginal net return for all the members was 96.2%. Farmers with low multiplication rates and high production costs per bag made lower marginal net returns (Annex 4a).

Considering resource allocation by UNSPPA members, the greatest proportion of resources was spent on seed (Annex 4b) Farm labor took 18.2%, fertilizers 8.5%, transport 7.3%, pesticides 6.4% and empty bags took 2.7%. Among the pesticides, the expenditure on insecticides was low. The bulk of this item was used to procure fungicides (90%).

Annex 4b. Resource allocation (Ush) in seed potato production by members of Uganda National Seed Potato Producers Association (UNSPPA) in 2000b season.

Names	Cost of seed	Farm labor	Fertilizer	Pesticides	Empty bags	Transport	Total cost
Belnamayo J.	500,000	500,000	40,000	50,000	20,000	40,000	1150,000
Bitarabeho F.	500,000	500,000	90,000	33,000	21,600	5,600	1150,200
Karibusho G.	500,000	500,000	42,000	50,000	36,000	140,000	1268,000
Kemani E.	150,000	150,000	5,000	7,800	2,000	2,000	316,800
Kihumuro A.	500,000	500,000	0	22,000	15,000	20,000	1057,000
Kiketunda B.	250,000	250,000	0	35,000	3,500	500	543,500
Kisizi K.	400,000	400,000	42,000	58,000	12,500	0	912,500
Mwongyera A.	60,000	600,000	86,000	45,000	53,000	87,000	1471,000
Ruberet E.	300,000	300,000	0	40,000	10,000	7,000	657,000
Sentaro P.	500,000	500,000	106,500	91,500	10,000	5,000	1213,000
Tindimubona	700,000	700,000	340,000	88,000	50,000	310,500	2188,500
Twesigye V.	150,000	150,000	0	50,000	8,500	24,000	382,500
Total	5,050,000	5,050,000	751,500	570,300	242,100	646,100	1,2310,000
Percent	56.9	18.2	8.5	6.4	2.7	7.3	100.0

US\$1 = Ush 1726.

Annex 5. Sensitivity analysis of the effects of changes in costs and revenues on farmers' margins.

Variable option	Total costs (Ush)	Yield (bags) 1 bag ~100kg	Price/bag (Ush)	Revenue (Ush)	Profit/loss (Ush)	Remarks
No fertilizer use	325,000	80	4,000	320,000	-5,000	Common with peasant farmers
No fertilizer and pesticide use	285,000	70	4,000	320,000	35,000	Common with subsistence farmers
No fertilizer use and land hire	300,000	80	4,000	320,000	20,000	Most common situation
No fertilizer use and land hire	300,000	80	5,000	400,000	100,000	Most common situation with off-season production

Source: Okobol and Ferris (2002) unpublished.

About FOODNET

The FOODNET project is a regional agricultural research and development network focusing on market-oriented research and sales of value-added agricultural products.

The overall project goal is to strengthen regional capacity in value-added, agro-enterprise technologies for increased income, improved nutrition, and sustainable food security in eastern and central Africa.

The project purpose is to identify market opportunities for existing and novel, value-added products, and optimize appropriate postharvest technologies to enhance the income-generating capacity of small- and medium-scale entrepreneurs from the private sector and promote products to improve nutrition.

FOODNET project partners are ASARECA networks, national programs, universities, international agricultural research centers, NGOs, CBOs, farmers, processors, manufacturers, and other agricultural sector stakeholders within the ASARECA region.

Researchers working with FOODNET use market survey techniques to identify market opportunities and work in close collaboration with a range of public and private sector partners to develop agroenterprise projects, using innovative postharvest technologies and products to supply both new and existing markets.

Agroenterprise activities will be developed using commercial models through the integration of market studies, improved technologies, and the development of partnerships with the various agents involved in the production to sales marketing chain.

To build capacity in this type of research, the network seeks to strengthen links between the private and public sector agencies and provide regional training in market studies and agroenterprise development to accelerate the process of change towards market-oriented research.

Project objectives are to:

- Identify market opportunities for increased sales of value-added products.
- Identify varieties with specific nutritional/processing qualities for germplasm enhancement.
- Identify, adapt, and promote improved postharvest technologies with private sector partners.
- Diversify product range from locally available crops for market expansion and improved nutrition.
- Provide training to strengthen the capacity of the network to deliver profitable agroenterprises.
- Develop postharvest information systems for increased access and exchange of information.
- Catalyze the process of change from production to market-oriented research in partnership with ASARECA networks and private sector partners.
- Enhance local, regional, intercenter, and international cooperation in postharvest activities.

About IITA

The International Institute of Tropical Agriculture (IITA) was founded in 1967 as an international agricultural research institute with a mandate for improving food production in the humid tropics and to develop sustainable production systems. It became the first African link in the worldwide network of agricultural research centers known as the Consultative Group on International Agricultural Research (CGIAR), formed in 1971.

IITA's mission is to enhance the food security, income, and well-being of resource-poor people primarily in the humid and subhumid zones of sub-Saharan Africa, by conducting research and related activities to increase agricultural production, improve food systems, and sustainably manage natural resources, in partnership with national and international stakeholders. To this end, IITA conducts research, germplasm conservation, training, and information exchange activities in partnership with regional bodies and national programs including universities, NGOs, and the private sector. The research agenda addresses crop improvement, plant health, and resource and crop management within a food systems framework and targeted at the identified needs of three major agroecological zones: the savannas, the humid forests, and the midaltitudes. Research focuses on smallholder cropping and postharvest systems and on the following food crops: cassava, cowpea, maize, plantain and banana, soybean, and yam.