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Farmer practices and adoption of improved potato varieties in Kenya and Uganda

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Comments are invited.

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Acronyms

ADC	Agricultural Development Corporation
CIP	Centro International de la Papa (International Potato Center)
FFS	Farmer Field School
FAO	Food and Agricultural Organization
IFAD	International Fund for Agricultural Development
KARI	Kenya Agricultural Research Institute
KAZARDI	Kachwekano Zonal Agricultural Research and Development Institute
MoA	Ministry of Agriculture
NAADS	National Agricultural Advisory Services
NARO	National Agricultural Research Organization
NARS	National Agricultural Research Stations
PRAPACE	Regional Potato and Sweetpotato Improvement Program for Eastern and Central Africa
SSA	Sub-Saharan Africa

Abstract

This paper describes the potato production practices of Kenyan and Ugandan farmers and the level of adoption of improved potato varieties as of November 2005. The majority of these varieties are from materials derived from the International Potato Center (CIP).

The study consists of 251 randomly selected households from the two major producing potato districts in Kenya (Meru, Nyandarua) and the two major potato producing districts in Uganda (Kabale, Kisoro). The most intensive potato farming among the four districts is found in Meru, Kenya. Seed rates as well as fertilizer use is higher in Kenya compared to Uganda, leading to 58% higher average yields in Kenya. However, higher cost of production in Kenya leads to lower returns to land and labor compared to Uganda for improved materials. Accounting for the cost of both hired and family labor, net returns when using improved varieties are USD 207/ha per season in Uganda compared to USD 152 in Kenya. In contrast, net returns when using local varieties are higher in Kenya (USD 84/ha per season) than in Uganda (USD 3).

The adoption of released varieties in various districts has been heavily influenced by market preferences. There is high adoption of Tigoni (38% of households in the district), an improved white skinned variety, in Nyandarua district, an area predominantly growing a local variety which is white-skinned, Nyayo (54%). In contrast, a well defined market and a premium price for medium sized red skinned potatoes exist in Meru Central. Consequently, the adoption of available improved white-skinned varieties has been challenged by local varieties that answer this specific market demand more precisely and thus fetch higher prices. Although there has been some adoption of an improved red-skinned variety, Asante (22% of households in the

district), the more profitable local red-skinned variety, Ngure, has remained predominant in the district (67% of households producing). In Uganda, Victoria (the same variety as Asante in Kenya), has been highly adopted (44%) due to its preferred characteristics: high yielding, early maturity and marketability. Victoria has even replaced other improved varieties, such as Cruza (17%) and Rutuku (10%), both considered to be more tolerant to late blight than Victoria. Results indicate that market demand must be a critical component in variety development, release and extension. It also stresses the importance of promoting improved varieties amongst consumers, traders and producers, rather than on the producer side alone.

Farmers underestimate the possible economic losses incurred through improper use of fungicides and are not aware of the health risk posed to them and their families from fungicide use. This leads to farmers underestimating the actual benefits of adopting late blight resistant varieties in the two countries.

The adoption of improved varieties is higher in Uganda than in Kenya. This may partly be explained by the higher economic benefit of adopting improved varieties in Uganda compared to Kenya and partly explained by the existence of superior seed systems in Uganda in the past 15 years. In spite of an average yield gain of 0.97t/ha in Kenya for farmers using improved varieties compared to local varieties. Interpreted at face value this might suggest that, farmers in Meru Central do not increase profits by adopting improved varieties as they receive a lower price on the market than local varieties, but additional analysis using multivariate analysis is necessary to distinguish the effect of varietal change from other confounding factors such as differences in input use or differences in environmental factors between farmers growing improved and local varieties. In Nyandarua farmers growing improved varieties earned USD 204/ha per year more than those growing local varieties. The average yield gain of 2.7t/ha from adoption of improved varieties in Uganda earns farmers an extra USD 358/ha per year, a large economic contribution to smallholder household income. Not surprisingly, over 60% of farmers in Uganda use improved varieties. In Uganda seed renewal rates by farmers were higher than in Kenya as was the availability and use of high quality seed. This may also have contributed to the higher adoption of improved varieties in Uganda.

Acknowledgements

This study is the outcome of collaborative field work between the National Potato Research Centre of the Kenya Agricultural Research Institute (KARI-Tigoni), the Kachwekano Zonal Agricultural Research and Development Institute (KAZARDI), which is part of the National Agricultural Research Organization of Uganda, the Ministries of Agriculture in Kenya and Uganda and the International Potato Centre (CIP). Special thanks go to Director of KARI-Tigoni, Dr. Jackson Kabira and the manager of KAZARDI, Imelda Kashaija, for the logistic support provided. We also wish to thank Rogers Kakuhenzire, Fredrick Nabimba and Innocent Uzatunga of KAZARDI, Uganda for their valuable field and professional support. Finally but not the least, we wish to thank Pamela Ochungo, an ILRI GIS analyst for her contribution in map work at planning and writing stage and all the enumerators and farmers in Kenya and Uganda who participated in this study. We would also like to recognize the Regional Potato and Sweetpotato Improvement Program for Eastern and Central Africa (PRAPACE) for its important role of promoting improved potato varieties in the region and providing technical assistance during the write-up. The study was jointly funded by IFAD and CIP's Impact Enhancement Division.

Farmer practices and adoption of improved potato varieties in Kenya and Uganda

INTRODUCTION

Potato production in Kenya and Uganda

The potato (*Solanum tuberosum*) is a staple food for many rural and urban families of East Africa. There is a growing trade in potatoes to supply the fast growing cities and towns with cheap staple food, and to satisfy the demand of the growing fast industry. 60-65% of the fresh potatoes supplied by urban traders in Kenya is processed in restaurants and street stalls (ECAPAPA et al., 2005; Kirumba et al, 2004).

According to 2005 FAO statistics, Ugandan potato production of 585,000t from 86,000 ha and Kenyan production of 980,000t from 120,000 ha, indicate national average yields of about 7- 8t/ ha for the two countries (Appendix 1). This is low compared to the 25t/ ha that can be attained by progressive farmers under rainfed conditions (Kinyae *et al,* 2004; Low, 2000; Aliguma, 2002). This yield gap can be attributed to high incidences of diseases, particularly late blight and bacterial wilt, the use of low quality seed potatoes degenerated by viruses, inadequate soil fertility management and poor general crop husbandry.

In Kenya, potato production is concentrated in the highlands (1500-3000m) of Central, Eastern and Rift valley provinces, in the districts lying on the Mau escarpment, the Aberdare range, and the edges of the rift valley and the slopes of Mt. Kenya. Based on geographic location, production practices and variety preferences potato growing areas are divided into five regions:

- Mt. Kenya, mainly comprising Meru CentralMeru Central, and parts of Nyeri and Laikipia districts;
- Aberdares and Eastern Rift Valley, mainly comprising of Nyandarua and parts of Nyeri, Kiambu and Nakuru districts;
- Mau, comprising Bomet, Narok and parts of Nakuru district;
- Mt. Elgon, comprising Keiyo and Marakwet districts;
- Others highlands, such as Taita in Taita Taveta in the southern border which have also started growing potatoes on a commercial basis (Appendix 5).

In Uganda, potatoes have traditionally been grown in the highland areas, which include Kabale and Kisoro districts of south western Uganda that produce the bulk of the potatoes and Mbale and Kapchorwa districts on the slopes of Mt. Elgon (Appendix 6). Kabale district alone produces 60% of the potatoes consumed in Uganda, although there has been growing interest in cultivation of potatoes in other districts.

Importance of late blight

Late blight caused by the fungus *Phytophthora infestans* can devastate a potato crop (Stewart and Bradshaw, 2001). Global estimates of economic damage as a result of yield losses and management costs of late blight in developing countries are estimated at $3 billion annually (Baker *et al.*, 2004; CIP, 2007[1]). The magnitude of losses of potato caused by late blight in African countries can range from 30 to 75% on susceptible varieties (Olanya *et al.*, 2001; Njuguna *et al.*, 1998). According to Nyakanga et al (2003) farmers lose up to 30% of potatoes due to late blight, with Meru Central farmers encountering even higher loses.

Due to high late blight pressure in the highland tropics, some farmers apply fungicides more than ten times per growing season (Namanda, 2004). Nyankanga et al (2004) estimated that 98% of potato farmers in Meru Central, Mount Elgon and Njabini division, Kenya rely on fungicides to protect their potato crop against late blight, with an average of 5 sprays per season. The most used fungicides are Ridomil, containing the systemic fungicide Metalaxyl as well as the contact fungicide, Mancozeb and different brands of Mancozeb alone, of which Dithane M45 is most used (Nyankanga *et al.*, 2004).

In Uganda, after potato was introduced by colonial administrators before mid 1900s, it rapidly spread in the highland areas as a garden crop, but was practically wiped out by late blight in 1946 (Akimanzi, 1982). Potato was later re-established through introduction of seeds from Kenya but yields have remained low due to lack of suitable varieties, poor agronomic practices, and disease problems. In Uganda late blight has remained an important constraint affecting level of production across the districts (Aliguma, 2002; Low, 2000 and Akimanzi 1982).

Investment in potato improvement

During the past 20 years Kenya Agricultural Research Institute (KARI) in Kenya and National Agricultural research Organization (NARO) in Uganda, in collaboration with International Potato Center (CIP) and Regional Potato and Sweetpotato Improvement Program for Eastern and Central Africa (PRAPACE) have released several improved potato varieties (Table 1). Most of the released varieties have late blight resistance to help farmers reduce losses to the disease (Olanya *et al.*, 2001; El-Bedewy *et al*, 2001; 1995, Kakuhenzire *et al.*, 2004).

In 1987 Uganda joined the PRAPAC (Programme Regional d'Amelioration de la Culture de la Pomme de Terre en Afrique Centrale) network which has been instrumental in revival and strengthening of Uganda National Potato Research and Development Program. PRAPAC was

[1] http://www.cipotato.org/potato/pests_diseases/late_blight (April, 2007)

founded in 1982 by the national research institutes of Burundi, Rwanda and Zaire to link their potato programs. Ethiopia and Kenya joined the network in 1992 which became PRAPACE and included sweetpotato in its programs. When Eritrea joined the network in 1995 it became a regional research network covering all ASARECA member countries.

In Kenya one of the oldest varieties is Kerr's Pink, which was introduced in 1927 and was still widely grown in 1992 (Crissman et al., 1993). The more recently released varieties Tigoni (CIP 381381.13) and Asante (CIP 381381.20) (Table 1) possess useful levels of late blight resistance. The two siblings were released to farmers in 1998 for their high yields and good quality traits, and superiority in late blight resistance compared to local varieties. Dissemination of the two varieties commenced in 1999 (KARI, 2004).

Table 1. Varieties released by KARI and NARO, 1927 to 2006.

Variety release by KARI, Kenya		Variety released by NARO, Uganda	
Variety name	**Year of release**	**Variety name**	**Year of release**
Kerr's Pink	1927	Rutuku (Uganda 11)	1972
Dutch Robyjn	1945	Malirahinda	1972
Rosline Eburu	1953	Makerere	1974
Annet	1972	Rosita	1974
Desiree	1972	Kenya Baraka	1977
Feldeslohn	1972	Sangema*	1989
Kenya Baraka	1973	Cruza *	1989
Roslin Gucha	1974	Victoria*	1991
Roslin Ruaka	1974	Kabale*	1991
Roslin Tana	1974	Kisoro*	1991
Roslin Bvumbwe	1974	NAKPOT-1*	1999
Kenya Chaguo	1988	NAKPOT-2*	1999
Kenya Dhamana*	1988	NAKPOT-3*	1999
Asante*	1998	NAKPOT-4*	2003
Tigoni*	1998	NAKPOT-5*	2003
Kenya-Sifa*[p]	2003	KACHPOT1*	2006
Kenya-Karibu*[p]	2003	KACHPOT2*	2006
Kenya-Mavuno*[p]	2003		
Kenya-Faulu*[p]	2003		

* Variety developed in collaboration with CIP

[p] Pre-released- hence had only been accepted as variety but would be officially released once KARI bulked sufficient seed stock

A Potato Improvement Program for Uganda was initiated in 1968 by Makerere University College and the Ministry of Agriculture with support from Rockefeller Foundation. The program objective was the development of potato varieties with multi-gene resistance to late blight (horizontal resistance). By 1974, a number of varieties were released in Kabale and Kisoro (USAID, 1994), of which Rutuku (CIP 720097) is among those still being grown today. However, due to civil war the

continuity and success of the program was interrupted affecting potato production in the country. The Ugandan program released other high-quality varieties in late 1980s and early 1990s which include Cruza (CIP 720108), Victoria (CIP 381381.2), Kisoro (CIP 381379.9), and Kabale (CIP 374080.5) and some are still being grown (Table 1), while the latest varieties were released from 1999 until 2006.

CIP and its partners have invested in development and promotion of high yielding and late blight resistant varieties for a long time. This study aims firstly at documenting the economic impact of these efforts on the potato sectors of Kenya and Uganda. Secondly, CIP and its partners hope to draw lessons from this study in regard to the effectiveness of variety development and promotion strategies in both countries. Thirdly, the key factors for successful variety introduction will be identified to be fed back to the potato breeding and variety selection programs of CIP and its research partners.

METHODOLOGY

Data collection took place between 10 and 29 October 2005 and between 1 and 25 November 2005 in Kenya and Uganda respectively. In each country two major potato producing districts were selected for the study. The districts were selected as representative of the potato sector of the countries, on the basis of a rapid appraisal that was executed before the final design of the study (Kaguongo et al 2005a; Kaguongo et al 2005b). In both countries a stratified sampling frame was used with sub-locations (parishes) and villages randomly selected within potato growing areas, and farmers were randomly selected in each village and interviewed by enumerators in dominant local language in a single visit. A structured questionnaire was drafted in collaboration with socio-economists, agronomists and plant pathologists from CIP, KARI (Kenya) and NARO (Uganda) and pre-tested with 20 farmers in each country. The questionnaire was then revised and refined using feedback from the field to help capture late blight management, variety choices, production levels, seed potato management, agronomic practices and potato production economics of the farmers (Appendix 7).

Sampling in Kenya

Nyandarua and Meru Central districts, which represent other potato growing districts in terms of varieties grown and management practices, were selected for the study. In Meru Central district, the 3 main potato producing divisions were sampled. All 15 locations in these divisions were included in the study. Seventeen sub-locations, representing 50% of the total 33 sub-locations in sample area were randomly selected. One village was sampled randomly per sub-location. A list of all farmers in the village was obtained from a village elder from which 6 farmers were randomly sampled. In Nyandarua district all divisions with their 20 locations were included in the study. About half (26) of 55 potato producing sub-locations were selected at random, from which a single village was sampled in which 6 farmers were selected randomly. Out of the 258 randomly selected farmers 251 were successfully interviewed.

Sampling in Uganda

Kabale and Kisoro districts being the major potato producing districts in the country were selected for this study. All the 4 counties and the 25 potato producing sub-counties in Kabale and Kisoro districts were included in the study. One parish was randomly selected from each sub-county and one village randomly selected within each parish. A list of all farmers in the village was then obtained from a village elder and 6 farmers were sampled randomly for interviewing. Out of the 150 farmers sampled 144 were successfully interviewed.

Analytical tools

Descriptive statistics are used to describe households, potato production, marketing, utilization and level of adoption of improved varieties. Benefits and cost are used to analyze gains from adoption of improved varieties in the two countries. Gains emanating from savings in costs of inputs and labor used and increased yields due to adoption of improved varieties are evaluated using net returns.

Definitions

Improved potato varieties

Potato varieties that have been developed or cleaned up for diseases by CIP in collaboration with National research stations since 1970 and are considered to be superior in qualities such as yields, resistance to diseases, dormancy period, maturity period or taste as compared to 'local' or existing varieties.

Improved varieties also include those varieties originating from trials conducted by NARS and selected and adopted by farmers because of their superior qualities but have not been out with the farmers for more than **35 years**.

Local potato varieties

Varieties with the farmers whose origin is unknown or varieties released by NARS but have been out with the farmers for more than **35 years** without being cleaned up for diseases.

RESULTS AND DISCUSSION

Farmers' characteristics

Farmers' characteristics influence farm management decisions and are important in understanding the adoption of improved technologies.

The mean number of household members did not vary much between countries although there were some small variations between district with Meru Central and Kisoro districts tending to have fewer household members. Gender distribution within families tended to be equal in all the four districts. The average age of the household head was 49 years in Kenya compared to 44 in Uganda (Table 2). In both countries 13% of the households were female headed.

Table 2. Demographic characteristics of selected farm families in survey.

Characteristics	Kenya			Uganda		
	Meru Central	Nyandarua	All	Kabale	Kisoro	All
Family size by gender						
All members	4.9	6.0	5.6	6.0	5.4	5.8
Standard deviation	2.3	2.5	2.5	2.3	2.2	2.3
Female members	2.4	2.9	2.7	3.1	2.9	3.0
Standard deviation	1.5	1.8	1.7	1.6	1.3	1.5
Male	2.5	3.2	2.9	2.9	2.5	2.8
Standard deviation	1.5	1.7	1.6	1.8	1.4	1.6
Average age of household head	49.1	49.3	49.2	44.8	43.0	44.2
Standard deviation	12.2	14.4	13.6	14.3	16.7	15.1
Percentage of household head						
Female	7	18	13	13	15	13
Male	93	82	87	87	85	87
Household head who have completed primary education						
Female	86	81	82	42	0	26
Male	92	93	92	89	63	80
Sample size	**100**	**151**	**251**	**95**	**49**	**144**

Source: CIP survey 2005

Many studies have found an association between education and use of technical advice. The level of education of household head in the sample in Kenya was generally high, with over 92% of

male and 82% female household heads having completed primary school. In Uganda 80% of the male household heads completed basic education, but only 26% of the female household heads. In Kisoro none of the female household heads had completed basic education.

Asset ownership

Cattle were important mainly in Kenya while small ruminants were important in both Kenya and Uganda. About 90% of households in Kenya had cattle compared to only 33% in Uganda (Table 3). Seventy-two percent of households in Kenya and 67% households in Uganda owned small ruminants (sheep and goat). Other livestock owned include pigs which are kept by 16% of sample farmers in Uganda, and donkeys kept only by 14 % of the farmers in Nyandarua, Kenya. On average Kenyan farmers had higher Tropical livestock unit (TLU)[2] compared to Ugandan farmers, indicating more manure could be available from their own herd. Livestock are mainly kept for milk production, consumption, sale and also as a saving and especially to mitigate risks of arable farming (Ashley and Nanyeenya, 2002). In the mixed crop-livestock production systems of the study areas livestock are also important as a source of manure and draft power for ploughing and ox-cart pulling.

A bicycle is the most common equipment and is owned by 53% and 46% of Kenyan and Ugandan sample farmers, respectively. Both ox-plough and ox-carts are only important in Kenya with only 10% and 12% of farmers, respectively owning them. Ox-carts and bicycles are important sources of transportation for humans and farm produce in rural areas while ox-plough provides a more efficient and affordable means of ploughing land.

Overall average farm sizes and cultivated areas of the sample farmers were relatively similar for the two countries. In Meru Central district land pressure is much higher than in Nyandarua, with 1.3 and 2.1 ha per household respectively. In Uganda land pressure in Kisoro is slightly higher than in Kabale with an overall average of 1.6 ha available per household.

Income from crop sales represented over 80% of total household income in Uganda (Table 4). In Kenya crops contributed about 51% of total income while livestock and remittances contributed 28% and 16% respectively. This shows that in both countries at least 80% of farmers' income from the two countries was farm dependent although farmers from Kenya depended more on livestock than those in Uganda. Surprisingly, off-farm income was not important, and contributed only 3% at most.

[2] Tropical livestock unit (TLU) is equivalent to 250 kg live weight as defined by Food and Agriculture Organization of the United Nations (FAO) .

Table 3. Asset ownership of selected households by districts.

Asset type	Kenya			Uganda		
	Meru Central	Nyandarua	All	Kabale	Kisoro	All
Livestock holdings						
Percentage of household owning						
Cattle	93	89	90	37	25	33
Small ruminants	69	74	72	63	75	67
Pig	2	0	1	18	6	16
Donkeys	0	14	8	0	0	0
Tropical livestock Unit (TLU)	2.6	3.3	3.0	1.1	0.5	0.9
Standard deviation	2.7	2.5	2.6	1.4	0.7	1.3
Median	1.9	2.4	2.2	0.5	0.2	0.4
Equipment						
Percent household owning						
Ox-plough	20	3	10	1	0	1
Ox-cart	14	11	12	1	0	1
Bicycle	31	67	53	49	40	46
Land ownership						
Average farm size (ha)	1.3	2.1	1.8	1.7	1.4	1.6
Standard deviation	1.2	2.0	1.8	1.6	1.0	1.4
Median	0.9	1.6	1.2	1.2	0.8	1.2
Average cultivated area (ha)	1.0	1.4	1.2	1.3	1.1	1.2
Standard deviation	0.8	1.4	1.2	1.4	0.7	1.2
Median	0.8	0.9	0.8	0.9	0.8	0.8
Sample size	**100**	**151**	**251**	**95**	**49**	**144**

Source: CIP survey 2005

Table 4. Most important income sources (%).

Source	Kenya			Uganda		
	Meru Central	Nyandarua	All	Kabale	Kisoro	All
Crop sale	55	48	51	80	88	82
Animals and animal products	18	36	28	8	2	6
Remittances	18	15	16	12	8	11
Other on-farm incomes	8	2	4	1	0	1
Off-farm income	3	1	2	1	3	1
Sample size	**100**	**151**	**251**	**95**	**49**	**144**

Source: CIP survey 2005

Farming systems

In all four districts there is a bi-modal rainfall pattern and farmers are able to produce at least two rainfed crops a year. However, there is considerable off-season farming in Meru Central and Kabale to fetch higher prices. In Kabale off-season farming is most notable in the swampy valley bottoms that have been reclaimed, while some farmers in Meru Central use irrigation to enable off-season farming (see Photograph 1).

Irrigation water is important in crop production especially where rain water is not adequate, is unreliable and where farmers want to synchronize harvesting with high prices in the market. Meru Central district in Kenya is distinctly different from the other sample areas as 72% of farmers produced some crops under irrigation while only about 7%, 11% and 8% used irrigation in Nyandarua, Kabale and Kisoro districts, respectively. About half of the farmers in Meru Central district used irrigation for potato production, irrigating about two-thirds of their area under potato. Sprinkler irrigation is the most common form of irrigation in Kenya while the few farmers irrigating in Uganda mainly use hand watering, drip or surface irrigation.

The sample farmers produced a variety of crops ranging from tuber crops to cereals and legumes. Potato was the most frequently grown crop, being grown by all farmers sampled although a few did not have potato in the field during the considered season due to rotation (Table 5). Maize was the second most important crop in Kenya, followed by vegetables. In Uganda the majority of households sampled were growing beans, sorghum and sweetpotato, while maize is only grown by slightly less than half of the farmers.

Photograph 1.
Farming system.

1a. Small fields in Kabale, Uganda.

1b. Farms in Nyandaru, Kenya.

Table 5. Description of farming system based on first season of 2005.

Characteristics	Kenya			Uganda		
	Meru Central	Nyandarua	All	Kabale	Kisoro	All
Percentage of household growing						
Potatoes	94	97	96	97	96	97
Maize	68	87	80	46	52	48
Vegetables	50	31	39	23	13	19
Beans	36	11	21	84	98	89
Wheat	19	11	14	15	8	13
Peas	9	3	6	30	6	23
Sorghum	2	8	6	84	48	73
Sweet potato	0	1	0.4	66	50	61
Bananas	0	1	0.4	34	19	29
Percent of farmers using irrigation	72	7	33	11	8	10
Percent of farmers irrigating						
Potatoes	52	3	22	8	6	7
Vegetables	92	5	40	7	2	5
Peas	8	1	5	0	0	0
Sample size	**100**	**151**	**251**	**95**	**49**	**144**

Source: CIP survey 2005

Potato production

Most sample farmers had potato growing experience of over 10 years, averaging 17 and 12 years in Kenya and Uganda, respectively.

Crop rotation is important to help maintain soil fertility and avoid the build-up of soil borne diseases. However, for crop rotation to be effective in controlling diseases it depends on the species of crops used in the rotation and number of seasons the field is free from plants of potato family. An often recommended rotation cycle is to grow potatoes only once in every four seasons. A wider rotation cycle would also help maintain soil fertility. Most farmers in Kenya and Uganda grow potatoes twice in a year, which constitute two major growing seasons (Table 6). Although the month of rainfall onset and intensity of rain vary from one region to another, the first season generally occurs during February- June rains while the second season occurs during October-December. However, using irrigation or residue moisture found in valley bottom fields some farmers are able to squeeze an off-season crop between June and September.

Table 6. Potato production practices by country: 2004/2005.

	Kenya			Uganda		
	Meru Central	**Nyandarua**	**All**	**Kabale**	**Kisoro**	**All**
Experience in growing potato (years)						
Average	18	17	17	12	11	12
Standard deviation	11	12	11	12	12	12
Median	18	14	15	11	6	7
Area grown potato per season (ha)						
Average	0.31	0.37	0.35	0.24	0.22	0.23
Standard deviation	0.30	0.32	0.31	0.26	0.19	0.24
Median	0.20	0.30	0.29	0.16	0.20	0.17
Number of potato plots grown by farmers in 1st season of 2005 (%)						
0	5	1	3	31	8	24
1	64	70	68	48	69	55
2	22	18	20	18	21	19
3	4	7	6	3	2	3
4-7	5	4	4	0	0	0
Percentage of farmers growing potato in same plot in 4 seasons (2004/2005)						
Once	18	16	16	56	62	58
Twice	45	35	39	37	30	35
Three times	27	23	24	6	4	6
Four times	10	27	21	1	4	2
Percentage of farmers growing						
Mono cropped potato plots	89	91	90	100	85	95
Potato-cereal/legume intercrop	19	11	14	2	15	7
Sample size	**100**	**151**	**251**	**95**	**49**	**144**

Source: CIP survey 2005

Although the majority of farmers (68% in Kenya and 55% in Uganda) had only one potato plot[3] during the first season of year 2005, at least 30% in Kenya and 20% in Uganda had two or more potato plots. A high percentage of farmers in Kabale had no potato plot during the first season of 2005. This is in line with the fact that in the same district high number of farmers were growing potatoes in a plot only once in four seasons.

In Kenya 21% of the farmers indicated they grow potatoes in the same plot continuously, with another 24% indicating to grow potatoes in the same plot 3 out of 4 seasons. Only 55% of the farmers practice some form of regular rotation, with at least 2 out of four seasons without potatoes. In Uganda 58% of the farmers indicated they grow potatoes only once in 4 seasons on the same plot, while in Kenya this was just 16%. However, the effectiveness of the rotation regimes in avoiding build-up of soil borne diseases is questionable since most farmers do not remove volunteer plants in the next season as they value the early sprouting volunteers as the source of early potatoes for home consumption. Although farmers in Kabale and Kisoro can easily expand their rotation cycle while retaining their current potato acreage, farmers in Meru Central and Nyandarua cannot expand their rotation cycle while maintaining their current potato acreages because the total cultivated land is less than four times the mean size of potato area.

Farmers in Kenya had larger areas under potatoes compared to those in Uganda. Nyandarua district had the highest mean potato area of 0.37 ha while Kisoro had the smallest mean potatoes area of 0.22 ha per season. Most potatoes were grown as mono crops both in Kenya and Uganda and only few plots were intercropped with either legumes, cereals or both.

Variety adoption and abandonment

Adoption of Improved and CIP derived varieties

The survey clearly indicated that the improved varieties released by national programs have been widely adopted in both Kenya and Uganda, but more so in Uganda than in Kenya. In Kenya 53.0% of farmers had adopted improved varieties compared to 77.8% of farmers in Uganda (Figure 1). Most farmers were growing improved varieties as pure stands although a few farmers were growing a mixture of improved varieties or a mixture of improved and local varieties. Similarly, the proportion of area under improved varieties was higher for Uganda compared to Kenya (Figure 2)[4].

However, in both countries CIP derived varieties occupied over 80.0% of the area under improved varieties. The area under CIP derived varieties in Kenya was 29.9% while in Uganda reached 69.3%.

[3] Smallest piece of land grown one or more crops and managed as a single unit.

[4] Only pure stands were considered

Figure 1. Percentage of farmers growing improved and local varieties.

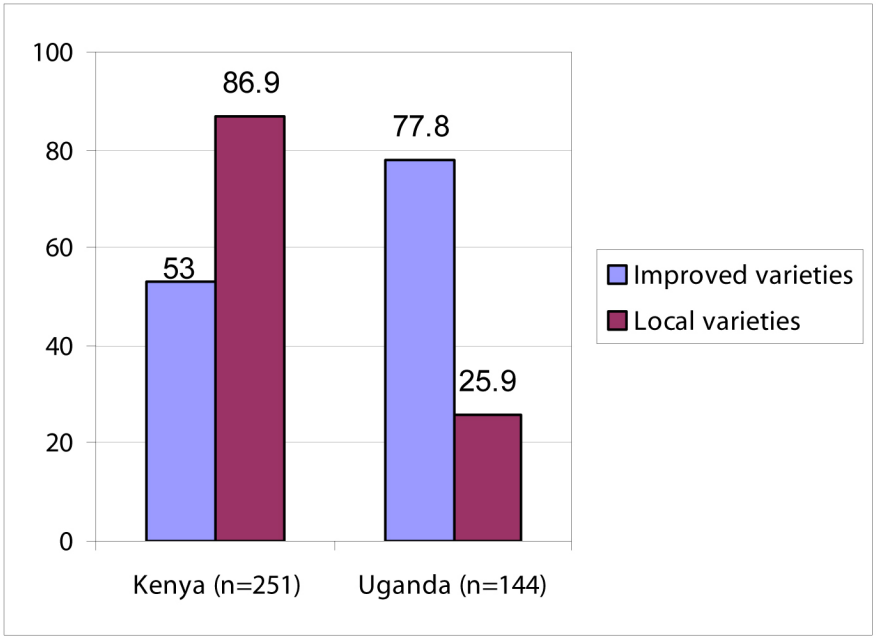
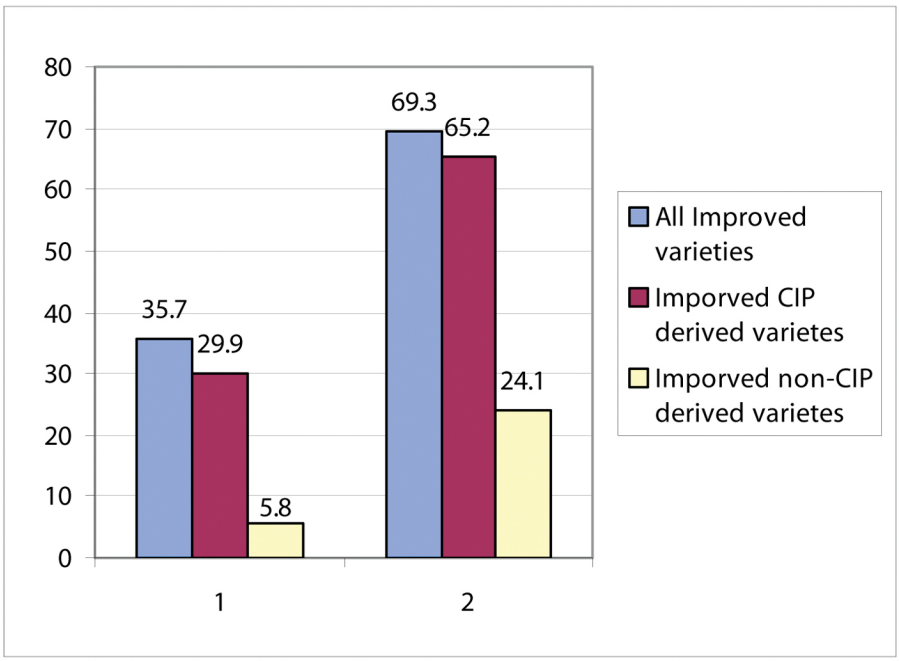


Figure 2. Proportion of area under CIP derived and non-CIP derived varieties.



Predominant varieties

In Kenya 25% of farmers are growing Tigoni while Asante and Desiree is each grown by 10% of farmers (Table 7). Diffusion of the varieties varies within the country, with some varieties diffusing faster and widely in selective districts based on their traits and target market in the region. There is a clear distinction between the two sample districts in variety preferences. Farmers in Meru Central almost exclusively grow red skinned potato varieties. In Nyandarua the three most frequently grown varieties (Nyayo, Tigoni, Tana Kimande) are white skinned (Photograph 2).

It is important to note that although high proportion of sample farmers in Kenya grew Nyayo the total area under Tigoni was larger than the area under Nyayo. Ngure was the second important in terms of production area followed by Nyayo. In Meru Central district the area under Ngure constituted about 39% of total area under potatoes while Kerr's Pink, Tigoni red and Asante the second, third and fourth important varieties constituted 14%, 13% and 12% of the potato area. In Nyandarua district Tigoni, Nyayo and Tana Kimande occupied about 68% of the area under potatoes while about 15 other different varieties occupied the remaining area.

As shown in Table 8 below the predominant varieties in each district have changed since 1976. Meru Central district which has had a history of growing Kerr's Pink, to an extent of the variety being called 'Meru', has largely abandoned it in favour of Ngure and Asante initially and later also 'Tigoni red'. Kerr's pink was predominant in 1976 with 100% of sample farmers growing it and it went slightly down to 92% in 1988, then to 51% in 2001 and finally to the 20% found in this survey. Currently, Ngure is the predominant variety in Meru Central district, with 67% of farmers growing it compared to 6% in 1988 (McArthur, 1989). This indicates a shift in variety preference of the growers in Meru Central, after growing Kerr's pink for several decades. The main reasons farmers stuck to Kerr's pink were market demand and the premium price it attracted in the market, in spite of its extreme susceptibility to late blight. Currently, Ngure fetches higher prices than Kerr's pink although the two have very similar characteristics, to an extent that consumers unknowingly also refer to Ngure as 'Meru', a name previously reserved for Kerr's Pink. The main reason for Ngure overtaking the Kerr's Pink is the emerging market that requires medium sized tubers and the fact that Ngure is rated slightly better than Kerr's Pink in terms of yield and early maturity (Table 13 and Table 15).

Photograph 2. Predominant varieties.

2a. Well managed white skinned potato (Tigoni) in Nyandarua, Kenya

2b. Well managed red skinned potato (Ngure) in Meru, Kenya.

2c. Some predominant red skinned varieties in Uganda.

Table 7. Potato varieties grown by sample farmers in Kenya in 2005.

Common name	CIP number or other identification	Skin color	Variety areas and percentage of farmers growing								
			Meru Central			Nyandarua			All		
			Farmers growing the variety (%)	Average area per farmer (ha)	Total area under variety (%)	Farmers growing the variety (%)	Average area per farmer (ha)	Total area under variety (%)	Farmers growing the variety (%)	Average area per farmer (ha)	Total area under variety (%)
Nyayo	Farmer selection	White	6	0.09	1.3	54	0.18	20.8	35	0.17	13.3
Ngure	Farmer selection	Red	67	0.25	39.3	1	-	-	27	0.25	14.9
Tigoni	CIP381381.13	White	5	0.41	4.8	38	0.36	29.0	25	0.36	20.1
Tana Kimande	Farmer selection	White	0	0	0	25	0.35	17.8	15	0.35	11.2
Kerr's Pink	UK	Pink	20	0.29	13.6	9	0.17	1.2	13	0.22	5.9
Tigoni red	Farmer selection from KARI trials	Red	30	0.18	12.7	1	0.03	0.0	12	0.17	4.7
Desiree	Holland	Red	12	0.21	5.9	10	0.16	3.4	11	0.18	4.3
Asante	CIP381381.20	Red	22	0.23	11.9	2	0.25	1.1	10	0.23	5.1
Komesha	Farmer selection	Red	8	0.16	3.0	10	0.38	8.1	9	0.30	6.1
Meru Mugaruro	Farmer selection	Pink	2	0.20	0.9	12	0.19	5.4	8	0.19	3.7
Arka	Holland	Red	7	0.17	2.8	0	0	0	3	0.17	1.1
Kihoro	Farmer selection	White	0	0	0	5	0.09	1.0	3	0.09	0.6
Nzenai	Farmer selection	White	3	0	0	0	0.13	0.9	2	0.13	0.6
Hubathuti	Farmer selection	White	0	0	0	3	0.18	1.0	2	0.18	0.6
Roslin Tana	UK	White	0	0	0	2	0.24	0.7	1	0.24	0.4
Shagi	Farmer selection	White	0	0	0	1	0.76	2.1	1	0.76	1.4
Kifururu	Farmer selection	Bluish	0	0	0	1	0.41	0.6	0.4	0.41	0.4
Chibishi	Farmer selection	White	0	0	0	1	0.81	1.1	0.4	0.81	0.7
Dutch Robijn	Holland	Red	0	0	0	1	-	-	0.4	-	-
Mixed varieties				0.33	3.9		0.51	5.8		0.42	4.9
Sample			**100**			**151**			**251**		

Source: CIP survey 2005

Table 8. Potato varieties in farmer's fields in Kenya between 1976 and 2005 (percentage of sample farmers).

Variety	Meru Central				Nyandarua		
	1976[a]	1988[b]	2001[c]	2005[d]	1976	1988	2005
Nyayo	0	6	0	6	0	92	54
Ngure	0	6	84	67	0	0	1
Tigoni	0	0	1	5	0	0	38
Tana	0	0	0	0	0	0	25
Kimande Kerr's Pink	100	92	51	20	59-81	0-15	9
Tigoni red	0	0	0	30	0	0	1
Desiree	0	8	0	12	0-4	38-46	10
Asante	0	0	20	22	0	0	2
Komesha	0	0	0	8	0	0	10
Roslin Tana	2	6	0	0	0	54-100	1

Source: [a]Durr & Lorenzi (1980), [b]Crissman et al. (1993), [c]Nyankanga et al (2004) and [d] CIP survey 2005
Note: Adoption figures for Nyandarua districts for 1976 and 1988 are obtained from Ol Kalou, Kipipiri and South Kinangop which are three divisions in the district

It is important to note that Ngure is considered to be slightly more susceptible to late blight than Kerr's Pink, which is a very susceptible variety. Interestingly Ngure seems to decline in importance compared to Tigoni red and Asante, as in 2001 Ngure was grown by 84% of farmers compared to 67% now. This may be because of the higher late blight resistance of Asante and Tigoni red and thus lower cash investment required and lower risks of crop loss.

In Nyandarua district the percentage farmers growing Nyayo increased from zero in 1976 to 92% in 1992 and then decreased to the current 54%. Roslin Tana reached 54 to 100% in Nyandarua district in 1988, but declined to only 1% in 2005. This indicate a rapid shift in variety choice in Nyandarua possibly because traders come looking for cheap white skinned potatoes with good properties for production of French fries. Apparently the traders in Nyandarua are not as specific about their variety choice as they are in Meru Central. This would allow farmers to try out other varieties that may be high yielding or are disease resistant more easily than in Meru Central, where a premium exists for 'Meru' potatoes. Also, potatoes from Nyandarua are marketed through the Wakulima market (Kirumba et al., 2004), through a large number of intermediaries. This results in a lack of communication between consumers, processors and retailers and the farmers. As a result there is a limited price incentive for higher quality potatoes, or a specific variety (Gildemacher et al., 2006).

In Kabale district in Uganda Victoria (called Asante in Kenya) is the most predominant variety followed by Rwangume, Cruza, Bumbamagara and then Rutuku (Table 9). In Kisoro district Kinigi

is the most important variety and is grown by 35% of farmers in the district. The variety draws its major market from the neighboring country, Rwanda and may be transported as far as Burundi. Victoria is the second important variety in the district, followed by Bumbamagara and Cruza.

In terms of production area Victoria was most important constituting 34% of total area under potato production. Respectively, Victoria constituted 36% and 31% of potato area in Kabale and Kisoro districts. In Kisoro district Kiningi was as important as Victoria and occupied 31% of total area under production.

Table 10 below shows there has been a substantial diffusion of Victoria.; Rueda et al. (1996) estimate the area under Victoria to be 3% in 1994, while Low (2000) estimated 39% of farmers in the region were growing Victoria in 1995, which had increased at the expense of Rutuku.
Rutuku was grown by 57% of farmers in 1995 compared to current 8%. The decline could be explained by the fact that farmers perceived Rutuku to be highly susceptible to bacterial wilt and has a long maturity period (Table 16). The attribute of early maturity in Victoria could also have contributed to farmers preferring it over Rutuku.

Kinigi, the most frequently grown variety in Kisoro district, was released in Rwanda in 1984 by National Programme for Potato Improvement (PNAP) (USAID, 1994) and introduced to Uganda by farmers. Farmers growing Kinigi in Uganda have increased from zero in 1994 to 6% in Kabale and 35% in Kisoro district. The farmers in Kisoro district market these potatoes partly to traders from Rwanda, through the small border crossing of Cyanika, close to Kisoro town.

According to the on farm trial data presented during the release of Victoria, Kisoro and Kabale in 1991 all the three varieties had high yield potential and useful degree of resistance to late blight (Table 11) (Sikka, 1994). Screening of bacterial wilt resistance at the National agricultural research laboratory at Nairobi indicated that Victoria also had high degree of resistance to bacterial wilt while Kabale was characterized by a moderate degree of resistance (Michieka, 1993).

Table 9. Potato varieties grown by sample farmers in Uganda in 2005.

Common name	CIP number or other identification	Skin color	Variety areas and percentage of farmers growing								
			Kabale			Kisoro			All		
			Farmers growing the variety (%)	Average area per farmer (ha)	Total area under variety (%)	Farmers growing the variety (%)	Average area per farmer (ha)	Total area under variety (%)	Farmers growing the variety (%)	Average area per farmer (ha)	Total area under variety (%)
Victoria	CIP381381.20	Red	49	0.19	36.5	33	0.20	30.5	44	0.19	34.0
Bumbamagara	Farmer selection	White	17	0.14	9.6	25	0.22	23.7	19	0.18	14.6
Cruza	CIP720108	White	18	0.18	13.1	17	0.18	12.9	17	0.18	13.0
Kinigi	CIP 378699.2[5]	Red	6	0.23	5.9	35	0.20	30.5	16	0.21	14.0
Rwangume	Unknown	Red	19	0.23	17.7	0	0	0.0	13	0.23	12.0
Rutuku	CIP720097	Red	15	0.11	5.6	0	0	0.0	10	0.11	3.8
Rwashakye	Farmer selection from NARO trails	Red	6	0.09	2.3	2	-	-	5	0.09	1.6
Kimuli	Farmer selection	White	4	0.16	2.7	0	0	0.0	3	0.16	1.8
Nakpot5	CIP381471.18	White	2	0.45	3.8	0	0	0.0	1	0.45	2.6
Kasaza	Unknown	Red	2	0.10	0.9	0	0	0.0	1	0.10	0.6
Kakyeri	Unknown	Red	1	-	-	0	0	0.0	1	-	-
Kenya	Kenya Baraka	White	1	0.12	0.5	0	0	0.0	1	0.12	0.3
Malirahinda	Malirahinda	White	1	-	-	0	0	0.0	1	-	-
Makerere	Makerere	White	1	-	-	0	0	0.0	1	-	-
Sutana	Unknown	Red	0	0	0.0	4	0.12	2.2	1	0.12	0.7
Katikamu	Unknown	Red	0	0	0.0	2	0.02	0.2	1	0.02	0.1
Mixed varieties				0.07	1.5		0	0.0		0.07	1.0
Sample size			**95**			**49**			**144**		

Source: CIP survey 2005

[5] Released in Rwanda by National Program for Potato Improvement (PNAP)

Table 10. Potato varieties in farmer's fields in Uganda between 1976 and 2005 (percentage of sample farmers).

Variety	Kabale			Kisoro		
	1994[a]*	1996[b]	2005[c]	1994[a]*	1996	2005[c]
Victoria	3	39	49	3	-	33
Bumbamagara	0	6	17	0	-	25
Cruza	23	25	18	23	-	17
Kinigi	0	0	6	0	-	35
Rwangume	0	0	19	0	-	0
Rutuku	30	57	15	0	-	0
Rwashakye	0	0	6	0	-	2
Kimuli	0	0	4	0	-	0
Nakpot5	0	0	2	0	-	0
Marirahinda	10	0	1	10	-	0

* Percentage of total area given
[a]Rueda et al. (1996), [b]Low (1996), [c]CIP survey 2005
Note: Adoption figures for Kisoro district for 1995/96 are not available but Kisoro was part of Kabale district in 1994.

The resistance levels against late blight reported on station are however not representative of the current levels of resistance. The level of late blight resistance of Victoria has dropped since its release as a variety. This is as a result of the adaptation of the pathogen to resistance mechanisms based on single genes, also called major gene or vertical resistance. However, the variety still has a useful resistance level, which makes late blight manageable for the growers and reduces risks of total crop loss compared to truly susceptible varieties. The current resistance level of Victoria is however lower than that of Rutuku and Cruza. The remaining level of resistance could be attributed to minor genes, the so-called horizontal resistance, which is durable and cannot be overcome by a simple mutation of the pathogen.

Table 11. On-station performance (1989-91) and attributes of some improved varieties during release of Victoria.

Variety	Maturing (days)	Mean yields (t/ha)	Resistance to late blight	Resistance to bacterial wilt	Dormancy (Weeks)	Storability
Victoria	Early (80-90)	35	High	High	Medium (6)	Good
Kabale	Late (110)	24	Moderate	Moderate	Long (9-10)	Excellent
Kisoro	Early (90-100)	28	High	-	Medium (6-8)	Good
Cruza	Late (115)	19	High	High	Short (2-4)	Fair
Rutuku	Late (95-120)	17	High	Low	Long (11-13)	Good
Sangema	Early (90)	14	Low	Low	Long (12)	Good

Source: Sikka (1994)

Out of the 32 tons of basic seeds produced between 1993 to 1994 Kabale consisted the highest proportion (26.2%) followed by Victoria (16.6%) (Appendix 3). However, adoption of Kabale has not been as high as that of Victoria possibly because of market and the fact that farmer prefer early maturing and a short dormancy period.

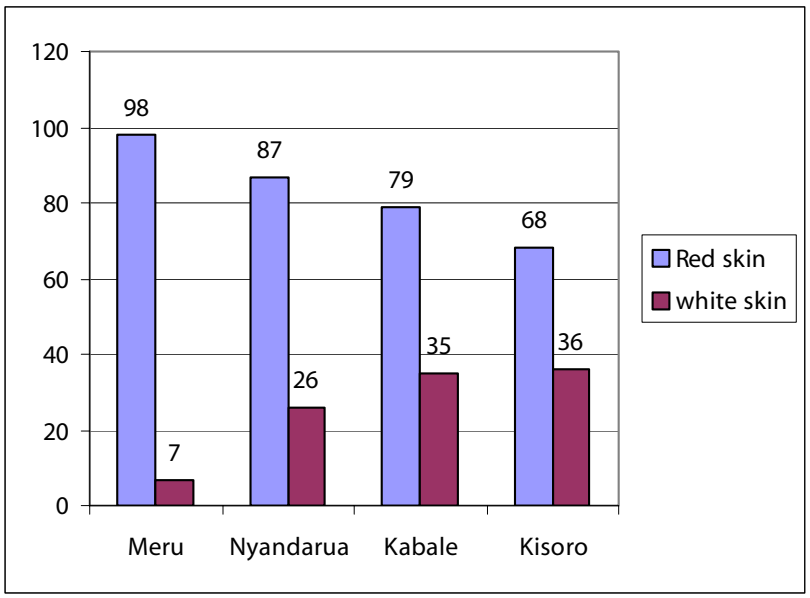
Influence of target market on variety adoption

The skin color of predominant varieties grown in each district is determined by the varieties preferred by the target market. The main colors are white/cream and red/pink. The target market for Meru farmers preferred red skinned varieties explaining why 98% of farmers in the district were growing red skinned varieties (Figure 3). A farmer growing white skinned potatoes is faced with lower demand and thus lower prices. This is mainly because middlemen and customers are willing to pay more for the preferred varieties. In Nyandarua the target market mainly preferred white skinned varieties and this explains why 87% of farmers were growing white skinned varieties compared to 27% who were growing red skinned varieties.

There was similar influence of market demand in Uganda, leading to 79% and 68% of farmers in Kabale and Kisoro respectively, growing red skinned varieties.

The market influence explains why red skinned variety such as CIP381381.20, which is called Asante in Kenya and Victoria in Uganda, has higher acceptance in Meru Central, Kabale and Kisoro districts while white skinned varieties have low diffusion, as is the case with Tigoni in Meru Central and Nakpot5 in Kabale districts. However, this skin color preference fully relates to marketability, and there is no relation between skin color and quality traits. This raises expectation for further adoption of Asante in Meru Central due to its high yielding ability in addition to having the preferred red skin.

Figure 3. Percentage of farmers growing red and white skin varieties.



Preferences for traits and attributes

When choosing varieties farmers look for specific traits and characteristics which suit their production and marketing situations. When asked to rank the good and bad qualities of varieties grown (without prompting) the most frequently considered attributes, in order of importance, were yield level, late blight resistance, taste, and maturity period (Table 12).

Table 12. Attributes considered when ranking good and bad qualities of varieties grown (% of farmers).

Attributes	Meru Central	Nyandarua	Kabare	Kisoro	All farmers
Yield level	87	78	63	57	74
Late blight Resistance	85	60	66	64	68
Taste	50	50	52	51	50
Maturity period	57	35	57	57	49
Marketability	31	38	67	55	45
Bacterial wilt resistance	23	46	64	40	44
Tubers size	33	45	32	28	36
Drought tolerance	28	24	29	2	28
Sample size	**100**	**141**	**95**	**49**	**385**

Source: CIP survey 2005

The ability of the varieties grown to supply the attributes which farmers perceive to be important were scored on a scale of 0 to 3 and then the mean score for each attribute was calculated for each variety (Table 13 and Table 14). This shows the attributes which farmers consider important and could be expected to influence farmers' variety choices.

High yield

Obviously farmers prefer varieties with a high yield potential (Table 12, Table 13 & Table 14). However, the overriding factor is market demand because most farmers grow potatoes for sale. This could explain why in Meru Central, Ngure continues to be more popular and also raises expectation for further adoption of Asante which is high yielding in addition to having the preferred red skin. However, some farmers may continue growing low yielding varieties in small quantities for home consumption if the variety has good taste.

The effect of market preference is also seen in Kabale and Kisoro districts where Nakpo1 and Nakpot5 have had low acceptance because they are white skinned despite their high yielding traits.

Table 13. Mean farmer scores of each attribute for ten common varieties in Kenya, 2005[a].

Attribute	Nyayo	Tigoni	Ngure	Tana Kimande	Tigoni-red	Asante	Desiree	Kerr's Pink	Komesha	Meru Mugaruro
High yielding	1.0	2.1	1.0	1.0	2.1	1.6	1.0	0.9	1.9	1.7
Late blight resistance	0.3	0.7	0.2	0.6	1.3	1.0	0.5	0.3	0.4	0.3
Tolerant to bacterial wilt	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.4	0.2
Early maturing	0.8	0.3	1.4	0.3	0.3	0.1	0.2	1.0	0.4	0.4
Big tubers	0.4	1.3	0.2	0.8	0.4	1.2	0.4	1.0	0.5	1.1
Drought tolerant	0.2	0.1	0.4	0.3	0.2	0.1	0.4	0.0	0.1	0.1
Tasty	0.6	0.3	1.0	0.3	0.5	0.6	0.8	1.1	0.3	0.2
Marketable	0.3	0.5	0.3	0.8	0.0	0.3	0.2	0.4	0.3	0.4
Good for mashing	0.4	0.1	0.0	0.2	0.0	0.0	0.6	0.2	0.1	0.2
Sample size	**90**	**64**	**64**	**37**	**29**	**25**	**23**	**25**	**22**	**19**

[a] Average score on a scale of 0-3, where 0= not a factor, 1= a slight factor, 2= an important factor, 3= predominant factor.

Table 14. Advantages cited by farmers of the eight common varieties in Uganda, 2005[a].

Attribute	Victoria	Bumbamagara	Cruza	Kinigi	Rwangume	Rutuku	Rwashakye	Kimuli
High yielding	1.7	0.3	0.4	1.8	1.0	1.6	1.3	0.0
Late blight resistant	0.1	0.6	0.9	0.8	0.2	0.8	0.1	0.0
Tolerant to bacterial wilt	0.2	0.1	0.5	0.3	0.3	0.2	0.1	0.8
Early maturing	1.2	2.0	0.3	0.3	0.5	0.2	0.8	0.0
Big tubers	0.4	0.1	0.4	0.4	0.2	0.4	1.1	0.2
Drought tolerant	0.0	0.1	0.6	0.0	0.2	0.0	0.3	0.2
Tasty	0.5	0.9	1.1	0.7	1.2	0.1	0.3	1.0
Marketable	1.0	0.1	0.2	0.8	0.6	1.1	0.6	0.8
Good for mashing	0.1	0.2	0.2	0.0	0.1	0.0	0.0	0.2
Sample size	**69**	**29**	**25**	**22**	**18**	**14**	**9**	**6**

[a] Average score on a scale of 0-3, where 0= not a factor, 1= a slight factor, 2= an important factor, 3= predominant factor.

Late blight resistance

Late blight is most damaging in areas with high rainfall and low temperatures which happens to be areas suitable for rainfed potato production in the tropics. Resistance to late blight emerged as an important attribute although farmers do not perceive the disease as a major limitation because they can control it using fungicides. Although use of fungicides for late blight control increases production costs, farmers felt it was a lesser problem compared to bacterial wilt which they do not know how to control. Farmers are also not wary of health risk posed to them and their families when applying fungicides, although they are aware of importance of late blight resistance in reducing production risks and cash requirement for buying fungicides. Lack of proper methods of storage, handling and use of fungicides in the tropics expose farm families and their workers to health risks potentially leading to economic burden due to cost of treatment and lost man days (Crissman et al., 2002; Cole et al, 1997). Adoption of late blight resistant varieties reduces the number of fungicides sprays required therefore reducing health risk and potential economic loss.

In Kenya, Tigoni and Asante were considered as more late blight resistant than the other Kenyan varieties (Table 12), which is in line with the findings at Tigoni national potato research centre (KARI, 2002). In Uganda, Cruza, Kinigi and Rutuku were scored higher in late blight resistance than Victoria which was considered quite susceptible (Table 14). This is contrary to findings from research stations during the time of variety release in 1991 which scored Victoria higher than Cruza in late blight resistance (UNPRDP, 1994; Sikka, 1994).

Although Victoria and Asante are the same variety, it is considered susceptible to late blight by Ugandan farmers while Kenyan farmers considered it resistant. This could be as a result of farmers comparing the variety against different benchmarks. Farmers in Uganda tend to compare Victoria with the more late blight resistant Rutuku and Cruza, while farmers in Kenya compare Asante with relatively late blight susceptible Nyayo, Ngure and Kerr's Pink.

Taste

Taste is important for the potatoes grown for home use and the attribute was constantly used by farmers when scoring varieties. However, preferences for particular tastes vary from one region to another. A variety described as tasty in one region may be considered tasteless in another region. Kerr's Pink and Ngure were scored high for their taste and could be one of the reasons the latter is able to take the place of the former in Meru Central. In Uganda, Rwangume, Kimuli, Bumbamagara and Cruza were rated relatively high for taste compared to other varieties.

Early maturity

Early maturity is important for food security and enabling households get income early to meet cash obligations such as school fees. It is also important in potato growing areas with high land pressure hence early harvesting allow growing more crops in a year. The trait is also important for Ugandan farmers cropping in valley bottoms because it enables them to squeeze a third crop during off-seasons period of June-September, when only the valley bottoms have residue moisture. During the short rainy season, that is often a bit erratic and can vary in length an early maturing variety also gives better chances of carrying the crop to full maturity without water stress.

In Meru Central, Ngure and Kerr's Pink were scored high for early maturity. In Uganda, Bumbamagara scored higher than other varieties for early maturity, followed by Victoria. Early maturity of Victoria is one of the major factors contributing to the success of its adoption and leading to farmer abandoning other varieties such as Cruza and Rutuku.

Bacterial wilt tolerance

Bacterial wilt is endemic in potato production areas in Kenya (Wakahiu et al, 2006) and Uganda. Bacterial wilt is considered a catastrophic disease by farmers as there is no easy chemical solution once it strikes. Thus farmer logically value tolerance to this disease as an important variety characteristic. No variety was considered tolerant to bacterial wilt in Kenya, while in Uganda Kimuli and Cruza were scored higher than other varieties in tolerance to bacterial wilt. Cruza's tolerance to bacterial wilt has previously been demonstrated through performance trials and farmers' ranking (Low, 2000).

Size of tubers

Most farmers prefer big tubers for home consumption and marketing. In Kenya farmers appreciate the large tuber sizes of Tigoni, Asante, Meru Mugaruro and Kerr's Pink. However, for reasons that are not clear an emerging market in Meru north prefers medium sized potatoes and that could be reason for Ngure becoming more popular than Kerr's pink in the area. In Uganda only Rwashakye scored relatively high for big tuber traits.

Short dormancy

In the two countries it was observed that farmers considered the length of seed dormancy to be important in their intensive potato farming practices. Once a crop is harvested, farmers like to plant tubers from the same crop as fast as possible in another field in the next season. If the tubers take a long period to sprout this hampers their field operations and timing hence farmers favour varieties with short dormancy as Victoria or Asante, Cruza and Nyayo.

Marketability

Comparisons between predominant varieties in each region (Table 7 and Table 9) and mean scores of variety attributes (Table 13 and Table 14) clearly indicate that during variety selection farmers are not only guided by the ability of the varieties to supply the attributes given prominence during scoring but other factors come to play. During attribute rating marketability did not feature dominantly, especially in Kenya, although examination of predominant varieties in each region indicates that marketability play a major role in variety choice. In Kenya none of the varieties scored more than 0.8 in marketability, yet there is high demand of red skinned varieties such as Ngure, Tigoni red, Asante and Kerr's Pink in Meru Central while there is high demand for white skinned varieties, such as Nyayo and Tigoni in Nyandarua. The explanation for farmers not giving high emphases to marketability when scoring attributes could be because farmers in each region in Kenya were largely growing varieties that have high demand. However, farmers in Uganda scored Victoria and Rutuku very highly in marketability. This is probably because in Uganda farmers were largely growing other less marketable varieties such as Cruza and Bumbamagara which were preferred by farmers themselves due to other traits like taste and early maturity.

Skin color was also hardly mentioned by farmers in both countries although close scrutiny of predominant varieties in each district indicate that market demand for a certain skin color strongly affects variety choice.

Variety abandonment

Over time some varieties have been rejected and replaced by others in Kenya and Uganda. Table 15 and Table 16 show the number of farmers who have lost interest in the six of most commonly abandoned varieties and major weaknesses cited by farmers for each variety. Low yield and susceptibility were cited as the major weaknesses of the highly abandoned Kerr's Pink, removing it from predominant position in Meru Central since early 1970 (Crissman, 1993; McArthur, 1989; Durr and Lorenzl, 1980). The decreased performance may be attributed to seed degeneration since Kerr's Pink has been known to be high yielding in past decades (Crissman, 1993; McArthur, 1989; Durr and Lorenzl, 1980). Desiree is the second variety which has been largely abandoned mainly due to low yield, poor market, poor taste and susceptibility to late blight. Farmers cited similar attributes as reasons for disliking the variety in its early stage of adoption (McArthur, 1989).

Table 15. Weaknesses cited by farmers of the six commonly abandoned varieties in Kenya, 2005**.**

Attribute	Kerr's Pink	Desiree	Nyayo	Ngure	Meru Mugaruro	Tana Kimande
Number of farmers abandoning	89	60	41	19	18	17
Percentage of farmers citing:						
Low yield	34	23	32	32	22	41
Susceptible to late blight	29	11	7	32	17	6
Small tubers	9	8	12	11	6	6
Susceptible to bacterial wilt	2	3	2	5	22	0
Poor market	1	17	29	0	11	0
Poor taste	1	13	7	0	6	11
Lack of seed	14	2	0	10	11	12
Sample size	**89**	**60**	**41**	**19**	**18**	**17**

In Uganda, Bumbamagara and Cruza were the most commonly abandoned varieties with poor market, small size tubers and low yield being cited as their major weaknesses (Table 16). Unlike Kenya, low market demand was commonly cited in Uganda as an important attribute behind farmers abandoning some varieties. Maturity period was also important in Uganda and was cited as one of the weaknesses leading to some farmers abandoning Cruza, Kimuli and Takabura.

Table 16. Weaknesses cited by farmers of the six commonly abandoned varieties in Uganda, 2005.

Attribute	Bumbamagara	Cruza	Rutuku	Kimuli	Makerere	Takabura
Number of farmers abandoning	46	41	23	19	12	11
Percentage of farmers citing:						
Low yield	20	15	22	21	42	27
Susceptible late blight	7	0	9	11	8	18
Small tubers	33	7	4	5	0	9
Susceptible to bacterial wilt	0	0	39	0	0	27
Poor market	22	34	4	37	33	0
Poor taste	2	12	0	0	0	0
Late maturing	2	27	4	18	8	18
Sample size	**46**	**41**	**23**	**19**	**12**	**11**

Important attributes determining adoption of improved varieties in Uganda

Although Victoria is less resistant to late blight and less tolerant to bacterial wilt, it is high yielding, early maturing and highly marketable. Kinigi is considered high yielding, resistant to late blight, tasty and marketable but lacks in attribute of early maturing which is important to the farmers. Compared to other varieties, Cruza shows higher level of resistance to late blight,

bacteria wilt and drought and is also considered tasty. However, the variety is relatively low yielding, late maturing and hard to market as a result of coloration of the vascular ring when fried, which makes it unsuitable for the French fries market in towns and cities. Rutuku is high yielding, has a high level of resistance to late blight and has the preferred red skin color. However, it is late maturing, as pointed out by farmers growing it, while those who have abandoned it say it is highly susceptible to bacterial wilt.

DISEASE INCIDENCES AND CONTROL

Late blight

Late blight is a problem for most sample farmers as reported by 92% of Kenyan sample farmers and 86% of Uganda sample farmers (Table 17). The disease was particularly important in Meru CentralMeru Central where 98% of farmers said it posed a problem. Only in Kisoro district, Uganda where relatively higher proportion of farmers (23%) said the disease was not important in production.

Most farmers in Meru Central, Kabale and Kisoro districts were aware of variety differences in levels of resistance to late blight. However, in Nyandarua district only 48% were aware of this.

Use of fungicides was the predominant method of controlling late blight with 77% of farmers in Kenya and 80% in Uganda reporting using it. Nyandarua district had the lowest percentage of farmers using fungicides. In both countries farmers predominantly use two types of fungicides, Mancozeb and Ridomil. Mancozeb, a preventative fungicide marketed in different brands is the most commonly used followed by Ridomil, which contains both the curative Metalaxyl as well as the preventative ingredients in Mancozeb. Most farmers in Meru Central use Mancozeb while in Nyandarua use of Ridomil is predominant.

In Uganda most farmers use Mancozeb formulations. A number of farmers in Uganda (17%) reported using insecticides to control late blight. A few farmers in Uganda did not know the name of the chemicals they used to control the disease.

On average farmers in Meru Central sprayed fungicides 4 times per season, while farmers in Nyandarua district sprayed only 2 times. Farmers in Kabale and Kisoro districts sprayed fungicides on average 3 times in a season.

Most farmers timed the first spray on the basis of the number of days after emergence or weeding or by the height of plant. About **32% of farmers in Kenya and 14% of farmers in Uganda began spraying when they could observe leaf infection.** In Kenya 21% used the predisposing conditions of chilly weather to determine the first time of spraying, while only 2% of Uganda sample farmers used such conditions as determinant. The fact that the start of spaying is determined by number of days after plant emerges or by appearance of leaf lesions, implies that a substantial proportion of farmers may be incurring higher losses than they realize.

Table 17. Late blight details by country**.**

	Kenya			Uganda		
	Meru Central	**Nyandarua**	**All**	**Kabale**	**Kisoro**	**All**
Percentage of farmers who:						
Consider late blight a threat	98	88	92	90	77	86
Are aware of variety differences in sensitivity to late blight	94	48	66	86	85	86
Percentage of farmers controlling LB by:						
Use of fungicides	99	62	77	81	77	80
Early planting	0	0	0	4	2	3
Weeding	0	0	0	2	2	2
Uprooting affected plant	0	0	0	1	0	1
What determines when to start spraying (%)*						
When leaves are affected	26	39	32	12	17	14
Immediately after emergence	33	1	18	38	37	38
Plant height	33	6	21	1	6	3
When cold/chilly weather starts	23	18	21	3	0	2
Some days before/after weeding	0	0	0	18	20	19
Count some days after emergency	14	45	28	33	20	29
Average number of sprays*	3.7	1.8	2.7	3.3	2.9	3.2
Standard deviation	1.9	0.7	1.7	1.5	1.0	1.4
Median	3.0	2.0	2.0	3.0	3.0	3.0
Percentage of farmers using*						
Mancozeb (mainly Dithane-M45)	96	2	52	74	76	75
Ridomil	22	88	53	17	6	14
Insecticide (Karate and Ambush)	2	0	1	16	18	17
Propineb based fungicide	1	7	4	0	3	1
Herbicides (Aqua Pro) & Dewormer (Nilzan)	0	2	1	0	0	0
Unknown	1	1	1	10	15	12
Sample size	**100**	**151**	**251**	**95**	**49**	**144**

*For proportion using fungicides
Source: CIP survey 2005

Farmers growing potatoes in the valley bottoms in Kabale district indicated they have fewer problems with late blight during the off-season period of June-September because it is not a rainy season. Only 3% of Ugandan farmers said they used early planting to control late blight. No farmer said they planted a variety with disease resistance to control the disease.

Going by attribute rating and varieties grown it appears level of late blight resistance is not a dominant factor for farmers determining the choices of grown varieties in the two countries as seen from the predominant varieties which are considered susceptible to late blight. When

ranked according to level of resistance to late blight diseases the most commonly grown varieties in Kenya and Uganda were rated very poorly (Table 18). Ngure and Nyayo which are the most predominant among Kenyan sample farmers were rated lowly among others in traits for tolerance to late blight. In Uganda, Victoria which is the most predominant variety was also rated poorest among other varieties.

Bacterial wilt

In all potato producing districts bacterial wilt is mentioned as an important disease and is reported to contribute to reducing yields. Farmers consider the disease more problematic because unlike late blight it has no chemical control and most farmers don't know how to control it. A few who know how to control the disease through crop rotation argue that their farms are too small to allow effective rotation. However, the economic importance of the disease is not clear. For example, in previous studies, in a region where the disease prevalence among farmers was reported to be as high as 91.2% the disease incidences was only 1.47% (Wakahiu et al, 2006).

Table 18. Rating of varieties according to level of resistance to late blight[a].

Kenya			Uganda		
Variety	**Mean**	**N**	**Variety**	**Mean**	**n**
Kihoro	2.7	14	Cruza	2.3	57
Tigoni	2.6	48	Rutuku	2.3	26
Tigoni red	2.6	48	Bumbamagara	2.2	63
Tana Kimande	2.4	19	Rwangume	2.1	14
Asante	2.3	40	Kinigi	2.0	36
Meru Mugaruro	2.4	14	Kimuli	2.1	18
Komesha	2.3	23	Rwashakye	1.7	26
Nyayo	2.2	33	Victoria	1.3	23
Arka	2.0	11			
Desiree	1.9	23			
Ngure	1.4	62			
Kerr's Pink	1.3	52			

[a] Average score on a scale of 0-3, where 0= not a factor, 1= a slight factor, 2= an important factor , 3= predominant factor.
Note: ranking was done by farmers who were aware of variety differences in disease tolerance
Source: CIP survey 2005

INPUT USE

Seed potato system

Sources of seed potato

In both Kenya and Uganda very few farmers procured clean seeds. Only 4% of farmers reported using seeds from sources likely to provide high quality seeds, such as trained farmer associations, seed growers and national research stations.

Self-supply is the most important source of seed for over 55% of potato grown in Kenya and Uganda (Table 19). This conforms to earlier studies (Low, 2000; Adipala, 1999) indicating self supply was the major source of seed supply for majority of farmers. Farmers select and store small tubers from their own production to plant the next season. The main reasons, as also stated by Nyangito (1986), are that this practice saves cash expenses. Furthermore, farmers may have more confidence in the quality of their own seed and with their own saved seed it is easier to plan production.

The second most important source of seed in Kenya was neighboring farmers while the market was second important in Uganda. Whereas neither of the two sources (neighbor or market) ensures clean seeds, obtaining seeds from neighbors may be slightly preferable especially where farmers obtain potato seeds from neighbors with potato fields in proximity after monitoring their growth.

Table 19 shows that most farmers obtain seed from their own harvest or buy seeds of uncertain quality from either neighboring farmers or the market. Reliable clean seed forms just a tiny proportion of the whole seed market. This can be attributed to several factors:

Firstly, the market for consumption potatoes is somewhat unpredictable as a result of the rainfed farming. When the season is good, prices go down as a result of glut reducing producer margins making farmers shy away from investing in clean seeds which are relatively more expensive.

Secondly, there is a lack of awareness amongst potato farmers about the importance of high quality seed to obtain high yields. The concept of seed degeneration as a result of virus diseases is not common knowledge among potato farmers. Farmers are known to look for new varieties as the variety they have has “become tired” or “lazy” and too “used to the environment”, which are basically farmers’ interpretations of seed degeneration, without understanding that the underlying cause is a build of diseases. Farmers rarely look for clean seed of the same variety but instead they look for a new “fresh” variety.

Table 19. Sources of seed for each variety grown in the last two seasons.

	Own	Neighbor	Market	Farmer association /seed growers or NARS	n*
Kenya					
All varieties	58	36	2	4	733
Nyayo	70	27	2	1	153
Tigoni	57	39	1	3	115
Ngure	34	51	3	12	97
Tigoni red	18	69	5	8	39
Kimande	84	16	0	0	74
Asante	40	46	3	11	35
Desiree	69	31	0	0	35
Kerr's Pink	37	48	0	15	27
Meru Mugaruro	64	33	0	3	39
Komesha	69	25	0	3	36
Uganda					
All varieties	56	15	25	4	357
Victoria	57	15	21	7	133
Bumbamagara	54	9	35	2	43
Cruza	65	5	30	0	37
Kinigi	35	18	47	0	34
Rwangume	63	20	9	9	46
Rutuku	56	11	33	0	18
Rwashakye	39	46	8	8	13

*n depends on number of plots grown in two seasons
Source: CIP survey 2005

Thirdly, high quality seed is not readily available. In Kenya there is no large scale seed potato production since the collapse of Agricultural Development Corporation (ADC) which was multiplying pre-basic seed into certified seed. KARI National Potato Research Center in Kenya and Kalengyere research station in Uganda are the single source of clean basic seeds in each country. Their capacity to produce this seed is limited as they are struggling with a double mandate of research and commercial basic seed production. They are handicapped by institutional arrangements in which there are limited incentives for increased productivity and efficiency. The multiplication of the limited amounts of basic seed stock produced by the national research programs into high quality seed potatoes also remains a major challenge. There is no large private sector involvement and only a small number of specialized and trained private seed potato multipliers.

Seed selection

The principle method of selecting seeds for farmers using own seed supply is sorting out tubers from the overall harvest, as reported by 90% of farmers in Kenya and 70% of farmers in Uganda. But this way the farmer has no knowledge of whether the seed comes from a healthy mother plant. In Uganda, at least 17% reported practicing some sort of positive selection while in Kenya only 3% reported using the technique. Of the farmers using own seed supply, the farmers who use separate seed bed as the principle method of seed production were only 3% in Kenya and 10% in Uganda.

Seed renewal

Many more farmers in Meru Central district renew seeds compared to farmers in all other districts visited in the two countries (Table 20). In Meru Central district, 75% of farmers renew seeds compared to only 21%, 25% and 25% in Nyandarua, Kabale and Kisoro districts. Of the farmers that reported renewing seeds, Meru Central farmers also renew more frequently than in other districts, with most Meru Central farmers renewing after every two seasons, while most farmers in other districts renewed seeds after eight seasons. This exception of high seed renovation in Meru Central district was also noted in 1988 (Crissman et al., 1993). Over the years farmers have purchased seeds from Kibirichia division, an area known to have low disease incidences due to high elevation. The area also neighbors mount Kenya forest, from where until recently farmers were allowed access to virgin land for potato production for short periods.

Higher rates of seed renewal in Meru Central are possibly due to a higher level of market integration, more stable prices for potatoes as a result of a more diversified and sure market, and the lower risks of production compared to other areas as a result of the availability of irrigation. Also since the production system is intensive and the rotation times the shortest of all four districts, there is likelihood of higher bacterial wilt pressure if seeds are not renewed regularly.

Seed sizes and rates

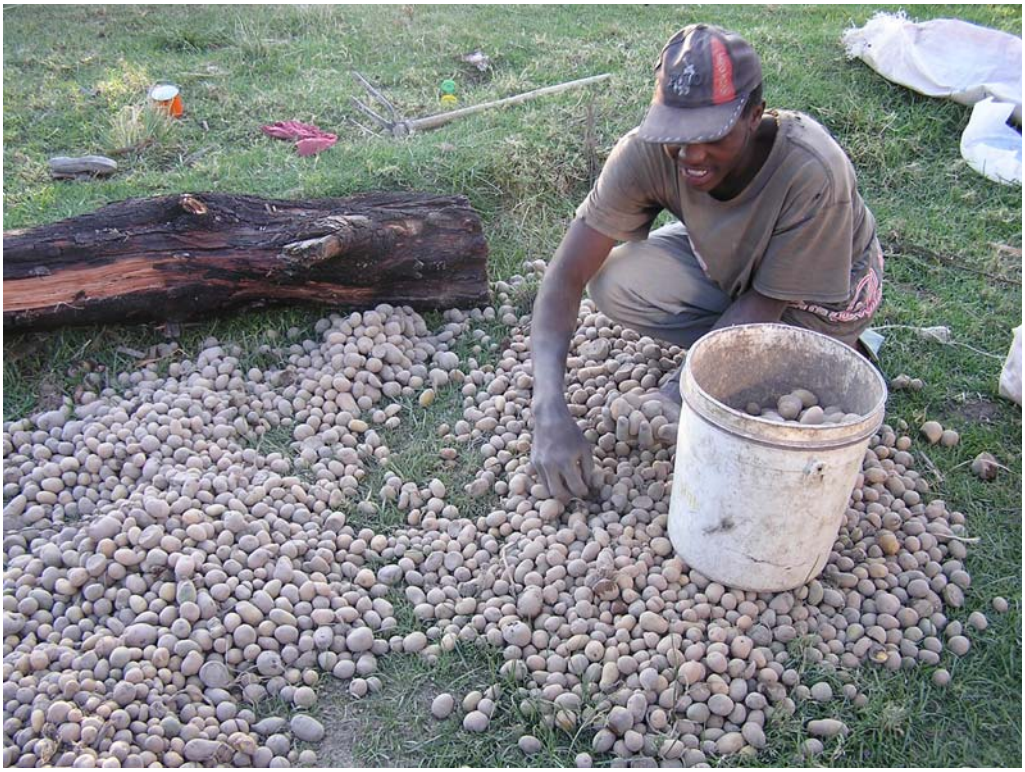
The majority of farmers in Kenya and Uganda used medium size tubers for seeds with 77% of Kenyan farmers and 60% of Ugandan farmers using medium size seeds. This is in line with earlier findings by Crissman et al. (1993), that the majority of farmers in Kenya preferred egg-sized seeds (Photograph 3). However, over 50% of farmers in Uganda also reported using small sized tubers. On average Kenyan farmers used about 50%, higher seed rates than Ugandan farmers, with Kenyan farmers using 1.6t/ha while Ugandan farmers used 1.1t/ha. However, the seed rate used by Kenyan farmers is still lower that the 2 tons/ ha recommended by the extension service (Durr and Lorenzil, 1980).

Comparing seed rates with the yields in Table 28, both countries have similar multiplication ratio, with Kenya having 5.91 and Uganda having 5.97. Going by this similar multiplication ratio, seed rate alone should contribute to higher mean yields in Kenya than Uganda by 50%. This multiplication ratio for Ugandan sample farmers is slightly higher than 4.8 observed in 1995 for Kabale (Low, 1996), although this does not show a corresponding increase in yields.

Table 20. Seed details by country.

Characteristics	Kenya			Uganda		
	Meru Central	Nyandarua	All	Kabale	Kisoro	All
Percentage of farmers renewing seeds	75	21	41	25	25	25
Number of seasons after which seeds are renewed*						
Average number of seasons	4.0	7.1	5.9	6.6	6.5	6.6
Standard deviation	3.0	2.1	2.9	2.7	3.9	2.7
Median	2.0	8.0	8.0	8.0	8.0	8.0
Percentage of farmers using						
Small size seeds	18	28	24	54	48	52
Medium size seeds	76	77	77	64	54	60
Large size seeds	9	6	7	16	15	15
Average seed rate by seed size (kg/ha)						
Small size seeds	1,129	1,467	1,388	1,024	632	919
Standard deviation	577	504	538	674	303	621
Medium size seeds	1,682	1,755	1,733	1,217	1,114	1,183
Standard deviation	589	638	624	723	556	672
Large size seeds	1,974	1,034	1,359	1,295	1,274	1,286
Standard deviation	715	499	729	1002	662	852
All seed sizes	1,605	1,664	1,647	1,142	976	1,089
Standard deviation	630	629	630	732	557	685
Price of seeds (USD/t)						
Average	104	50	72	119	120	119
Std	34	25	41	85	85	85
Median	100	37	66	105	105	105
Sample size	**100**	**151**	**251**	**95**	**49**	**144**

*Those farmers who renew seeds
Source: CIP survey 2005



Photograph 3. Farmer selecting egg–sized tubers in Meru, Kenya.

Seed prices

Nyandarua in Kenya had the lowest mean seed price compared to all the districts in the two countries, possibly because of generally low ware potato prices in the district. Seed prices in Uganda were high, reaching USD 119/t compared to Kenya with USD 72/t (Appendix 4). However, the median seed prices for Meru Central, Kabale and Kisoro districts were almost the same (Table 20).

Prices of seeds varied by varieties and from one region to another, with prices of most improved varieties having higher mean price compared to local varieties (Appendix 2). Although improved varieties mainly grown in Meru Central district, such as Asante and Tigoni red had slightly higher seed prices Ngure, a local variety had relatively high price as well. Kerr's Pink which is currently being abandoned in Meru Central district is among the local varieties with lower seed price. Nyayo, the most predominant variety in Nyandarua district is among the variety with the lowest seed price in the country.

In Uganda, Victoria, Cruza, Kinigi and Rutuku are among varieties with high seed price. However, Rwashakye has high seed price although it is a local variety.

First source of seed

As shown in Table 21, neighbors were the major source of *first seeds*[6] of all varieties grown in Kenya. Neighbors were the source of 84% of all varieties grown by Kenyan farmers while markets, farmers' association and seed growers or government department formed the other sources of first seeds. In Uganda, the market was the most important source of first seed (45%) of varieties grown while neighbors were the second important source of first seed (35%). In Uganda more *first seeds* originated from sources known to produce clean seeds (13%), such as commercial seed growers, the ministry of agriculture or national research stations compared to Kenya (6%),

Seed storage facilities

Most sample farmers stored seeds. Only 8% of farmers in Kenya and 11% of farmers in Uganda said they did not store seeds. Dark storage and a field pit are the main storage techniques used by farmers in Kenya (Table 22). In Meru Central, the percentage of farmers storing seed in a field pit have declined from 100% in 1976 (Durr and Lorenzl, 1980) to 34%. In Nyandarua, farmers storing seeds in their houses have also declined from about 50% in 1976 to less than 25% in 2005, with the majority of them using stores.

In Uganda a dark space in the house was the most common storage facility, followed by a light store and a light space in the house as reported by 36%, 31% and 16% of sample farmers.

Seed potatoes were mostly spread out on the floor as was reported by 48% of farmers in Kenya and 73% of farmers in Uganda. However, in Kenya a substantial proportion of farmers reported storing seeds in gunny bags (24%) or a wooden structure (20%).

[6] Seeds used by the farmer to grown a given variety for the first time.

Table 21. Sources of seed during the first time of growing.

	Neighbor	Market	Farmer association	Seed growers/ MOA/ NARS	n
Kenya					
All varieties	84	3	7	6	442
Nyayo	86	7	3	4	90
Tigoni	79	3	2	16	62
Ngure	84	1	13	2	67
Tigoni red	88	0	12	0	32
Tana Kimande	84	8	0	8	38
Asante	76	0	16	8	25
Desiree	95	0	0	5	22
Kerr's Pink	64	8	20	8	25
Meru Mugaruro	94	0	0	6	17
Komesha	82	0	4	14	22
Uganda					
All varieties	35	45	8	13	200
Victoria	37	38	14	11	65
Bumbamagara	28	69	0	3	29
Cruza	38	46	8	8	26
Kinigi	18	61	4	17	23
Rwangume	35	35	6	24	17
Rutuku	29	57	0	14	14
Rwashakye	56	11	0	33	9

Source: Own source

Period of storage

Farmers in Uganda store seeds for longer periods compared to farmers in Kenya (Table 22). Farmers in Meru Central district stored seeds for the shortest period, with median of 30 storage days, followed by Nyandarua district with median of 60 storage days. This pattern of storage follows earlier observation by Durr and Lorenzl (1980) that Meru Central had average storage period of 3 weeks while Nyandarua had mean storage of between 6 to 9 weeks. In Uganda farmers in Kisoro district stored seeds for longer period, with a median of 90 storage days, while Kabale farmers stored seeds for 60 days. This long storage period means seeds harvested in one season are not mainly used for consecutive season but must skip one season, possibly due to long dormancy period.

Sprouting

In Meru Central district more than 90% of farmers reported using various methods to force sprouting while a substantial proportion of farmers in Nyandarua, Kabale and Kisoro districts did nothing to induce sprouting (Table 22). Most farmers in Meru Central districts used a pit to induce sprouting while others covered seeds using dry leaves or put them in bags or warm places. In Nyandarua district farmers who induced sprouting mainly used dry leaves or used pits. In Uganda, farmers who induced sprouting mainly put seeds in bags, covered them with dry leaves or put them in warm places.

Fertilizer application

In Kenya 89% of farmers reported using chemical fertilizer compared to only 7% in Uganda (Table 23). The low adoption of fertilizer use in Uganda is clearly related to the very limited availability of agrochemical suppliers at county and sub-county levels[7] in Kabale and Kisoro districts. It is however unclear whether the low fertilizer use is a result of, or to blame for this lack of supply. The finding reaffirms earlier findings by Kaguongo et al (2005b) that only farmers around Kapchorwa district in Uganda use fertilizer, estimating 40% of potato farmers in the district to be fertilizer users.

In Kenya, Di-ammonium Phosphate (DAP[8]) is the most commonly used type of fertilizer as reported by 96% of users. Only 8% and 1% respectively, reported using Calcium Ammonium Nitrate (CAN) and compound fertilizer (NPK).

Sixty-one percent of farmers who were not using fertilizer in Kenya sited lack of cash and high fertilizer prices as their main reason for not using fertilizer while in Uganda 50% sited similar problems. In Uganda 26% of nonusers said they believed their land was adequately fertile for potato production while interestingly only 9% said fertilizer was not available.

[7] Administrative units smaller than a district- one district is made up of several counties and a county consists of several sub-counties .

[8] DAP has 18 % nitrogen and 46% phosphorous.

Table 22. Seed storage details by country.

	Kenya			Uganda		
	Meru Central	**Nyandarua**	**All**	**Kabale**	**Kisoro**	**All**
Percentage of farmers storing seeds	83	99	92	93	81	89
Type of store used by farmers (%)						
Dark store	61	44	50	15	8	13
Field pit	34	14	21	1	0	1
Lit store	5	12	10	25	44	31
Dark space in the house	2	19	13	37	33	36
Lit space in the house	0	8	5	19	10	16
Storage methods used by farmers (%)						
Gunny bags	12	30	24	5	5	5
Wooden structures/ shelves	24	18	20	7	3	6
Heaps	28	9	16	13	23	16
Spread on floor	39	53	48	74	72	73
Seed storage period (days)						
Average	45	55	51	74	75	74
Standard deviation	26	29	28	28	21	26
Median	30	60	30	60	90	65
Measures taken to speed sprouting (%)						
Nothing	8	49	33	32	41	34
Use pit	57	11	29	4	7	5
Cover with dry leaves	19	22	21	7	17	17
Put in warm place	5	7	6	24	14	12
Put in bags	7	4	5	17	19	18
Sample size	**100**	**151**	**251**	**95**	**49**	**144**

Source: CIP survey 2005

Table 23. Fertilizer application details.

	Kenya			Uganda		
	Meru Central	**Nyandarua**	**All**	**Kabale**	**Kisoro**	**All**
Percentage of farmers using chemical fertilizer	92	87	89	6	8	7
Fertilizer users applying						
DAP	93	98	96	0	75	43
CAN	13	4	8	33	25	29
NPK	1	1	1	67	0	29
Amount of fertilizer applied (Kg/ha)						
Average DAP used	295	248	267	0	331	330
Standard deviation	164	212	195	0	222	222
Median	248	165	248	0	402	402
Percentage of farmers using						
Organic fertilizer (manure)	53	46	49	15	31	20
Average manure used (kg/ha)*	4,287	1,344	2,535	1,086	2,502	1,946
Standard deviation	3,954	2,237	3,365	1,678	4,087	3,382
Median	2,961	668	1,069	556	620	588
Sample size	**100**	**151**	**251**	**95**	**49**	**144**

Source: CIP survey 2005

Farmyard manure

Farm yard manure could be an alternative or supplement to chemical fertilizer because it contains a variety of nutrients and improves soil structure, which helps soil water retention capacity. However, it is recommended to use very well composted farmyard manure or apply it on the crop before potatoes instead of directly on the potato field. Especially in seed potato production it is not recommended to use farmyard manure just before planting. The use of badly composted manure increases incidences of Rhizoctonia. Farmers however rarely have enough from their livestock to satisfy the full crop nutrient demand, while a manure market is not well established both in Kenya and Uganda. As a result of the higher number of livestock, more farmers reported using farm yard manure in Kenya (49%) compared to Uganda (20%).

TOTAL OUTPUT, STORAGE, MARKETING AND UTILIZATION

Kenyan farmers harvested twice as much potatoes per household than Ugandan farmers mainly because they had slightly larger fields and a higher yield per hectare (Table 24). Most farmers from both countries however, do not store potatoes but sell directly from the field leading to glut periods and depressed prices. This makes the rain dependent farmers very prone to exploitation by brokers and traders. Also the brokers and traders do not store ware potato but deliver the produce directly to the market. This results in widely fluctuating farm gate and market potato prices, sometimes with the minimum and maximum prices varying by more than 70% (Kaguongo et al, 2005a; Kaguongo et. al, 2005b). Storage of potatoes can help in leveling prices, assuming lack of storage capacity rather then immediate cash needs are the main reason for selling potatoes straight form the field.

Marketing

Most of the sample farmers in Kenya and Uganda produced potato commercially and over 80% of farmers had sold potatoes at least once in the last two seasons. Out of the few farmers who did not sell any potato in Meru Central, Kabale and Kisoro districts, 90% said they produced just enough for the family. However, in Nyandarua district 22% of farmers said they refused to sell, and consumed or fed the potatoes to livestock because the prices were too low.

Meru Central district has the highest proportion of marketed potatoes with farmers selling 80% of potato produced and consuming 9%, keeping for seed 8% and feeding to livestock or disposing as wasting only 1% (Table 24). Nyandarua district has the highest proportion of potatoes fed to livestock or wasted, confirming the farmers' assertion that a lot of potatoes go to waste because of poor prices and impassable roads due to bad weather.

Packaging

Farmers usually harvest potatoes when a field broker indicates a trader is coming (Photograph 4). They sell potatoes packed in bags of different sizes which are supplied by traders and have different weights when filled. Due to use of extended bags[9] farmers sometime are not able to know the actual amount they pack in the bag since they sell using bags instead of weight. According to an informal survey by Kaguongo et al, (2005a) instead of using a standard bag of 100-110 kg per bag some farmers used extended bags that contain between 120 and 200 kg of potatoes depending on target market. The use of extended bags was particularly common in Uganda and Nyandarua district in Kenya (Table 24).

[9] Wares are stacked above the brim to form a mound which is held together using net of strings.

Photograph 4.
Packing.

4a. Potatos packed in standard bag in Kabale, Uganda.

4b. Potatos packed in extended bag, Nyandarua, Kenya.

Table 24. Potato output, utilization and marketing details by country.

	Kenya			Uganda		
	Meru Central	**Nyandarua**	**All**	**Kabale**	**Kisoro**	**All**
Production per farm (kg)						
Average	2,734	3,348	3,110	1,651	1,446	1,572
Standard deviation	3,262	4,883	4,329	2,275	2,128	2,212
Median	1,788	1,980	1,876	823	1,020	880
Proportion of potatoes:						
Marketed	80	65	70	60	64	62
Consumed at home	9	16	14	18	18	18
Kept for seed	8	15	13	20	17	19
Feed to livestock/ wasted	1	4	3	1	1	1
Market outlets for farmers (%)						
Middleman	98	92	94	37	44	39
Village market	2	6	4	45	13	35
District/capital market	2	4	3	15	41	23
Major trader	0	2	1	15	8	12
Neighbour	1	1	1	2	3	3
Farmer association	0	0	0	1	3	2
Packages used for selling (%)						
100-110 kg bag	97	85	90	57	59	58
120-140 kg bag	2	8	5	29	21	26
150-200 kg bag	0	2	1	0	10	4
15-20 kg buckets	1	6	4	8	3	6
Farm gate prices (USD/t)						
Average	94	49	68	92	76	88
Standard deviation	24	23	32	44	32	42
Median	87	37	63	96	77	91
Marketing problems encountered (%)						
Low prices	85	95	93	49	66	54
Difficult getting buyers	33	36	35	50	59	53
Long distance to market	6	24	19	53	41	49
Lack of packaging standards	10	20	17	4	0	3
Poor roads	17	15	15	20	2	15
Persons making decision to sell (%)						
Husband	44	41	42	28	18	25
Wife	12	34	25	24	25	24
Husband and wife	44	24	32	56	55	55
Son or daughter	0	1	1	0	3	1
Sample size	**100**	**151**	**251**	**95**	**49**	**144**

Source: CIP survey 2005

Market outlets

Middlemen formed the major market outlets for farmers in both countries. In Kenya over 90% of farmers sold their ware potatoes through middlemen, while village and district markets formed market outlets for very few farmers. In Uganda, although middlemen formed important market outlets, village and district markets combined formed the major outlets for the farmers. In Kabale district particularly, the village market is the most important market outlet for most farmers.

Farm gate prices

Both in Kenya and Uganda, prices of potatoes vary with the season, region and skin color. Price variation occurs from one season to another and from one division[10] to another based on market characteristics, such as distance to markets and road conditions. Farm gate prices are lowest during harvesting time, especially when it rains in areas with poor roads. Average farm gate prices in Meru Central district were higher than in Nyandarua district (Table 24), a finding reflected in earlier observation by Durr and Lorenzl (1980).

Meru Central district has the highest mean price of USD 94/t and higher seasonal and regional variations while Nyandarua has the lowest mean prices of USD 49/t and lower seasonal and regional price variations. An informal survey indicated that farm gate prices in Meru Central ranged between USD 61.8/t to 149.4/t while in Nyandarua district it ranged between USD 42.1/t to 57.1/t (Kaguongo et al., 2005a).

Ngure, the predominant variety in Meru Central district has the highest farm gate price among all the varieties in Kenya, averaging USD 97/t (Table 25). In order, Ngure is followed by Asante, Desiree, Tigoni red and then Kerr's Pink.

In Uganda, farm gate price for Kisoro district was 17% lower than that of Kabale district, with Kisoro district price averaging USD 76/t while Kabale district averaged USD 92/t.

Farm gate prices in Uganda also varied with variety, with improved varieties fetching slightly higher price than local varieties (Table 25). Victoria and Rutuku had the highest farm gate price followed by Kinigi while. Bumbamagara and Rwangume are among the varieties with the lowest farm gate prices (Appendix 2).

[10] Several administrative units make one district

Table 25. Prices of potato seeds and wares by varieties**.**

Kenya				Uganda			
	Prices		n		Prices		n
	Seed	Ware			Seed	Ware	
Improved				Improved			
Tigoni	49	46	30	Victoria	133	98	61
Asante	109	94	19	Cruza	124	74	11
Tigoni red	114	79	17	Kinigi	167	89	22
Desiree	80	80	5	Rutuku	170	98	8
				Rwashakye	128	79	3
Local				Local			
Nyayo	40	38	41	Bumbamagara	96	71	20
Tana Kimande	55	55	23	Kasaza	70	70	3
Ngure	101	97	41				
Kerr's Pink	73	68	10	Source unclear			
Komesha	79	75	12	Rwangume	84	81	18
Kihoro	37	37	2				

Source: CIP survey 2005

Marketing problems

In Kenya, low prices were the most important constraints in potato production, especially for Nyandarua district farmers. Lack of buyers was the second important problem followed by long distance to market, and the two problems were particularly important with Nyandarua district farmers. Lack of packaging standards was also cited as an important constraint especially in Nyandarua district. In Uganda, problems of lack of buyers and long distances to the market were as important as low prices as each was cited by about half of farmers.

Decision making

Although the study did not establish how income from potatoes was spent by the household members it is expected that the person making the marketing decision is likely to determine how the family will spend the income. In Kenya, the decision to sell potatoes was mainly made by the husbands while in Uganda the decision was mainly made by both husband and wife (Table 24).

Credit

Credit is important in assisting farmers with cash flow problems, to acquire new technologies or smooth cash flow problems for farm operations. However, few farmers in Kenya and Uganda have access to credits or loans and rarely do stockists sell inputs to farmers on credit. Only 2% of farmers in Kenya and 15% of farmers in Uganda reported receiving a loan in the last two years

(Table 26). Most of the loans were mainly from micro-finances or from farmers' savings and credit groups. About 80% of farmers who received loans in Uganda said they used it for potato farming.

Table 26. Group membership and credit.

	Kenya			Uganda		
	Meru Central	**Nyandarua**	**All**	**Kabale**	**Kisoro**	**All**
Percentage of farmers given credit	2	1	2	14	17	15
Percentage of farmers in a farmer group	27	23	25	36	42	38
Percentage of farmers getting advice	25	14	18	32	29	31
Sample size	100	151	251	95	49	144
Number of times advised *						
Mean	1.7	2.0	1.8	3.7	2.2	3.2
Standard deviation	0.7	1.4	1.0	2.6	1.5	2.4
Median	2	2	2	3	2	2
Sources of information*						
Extension worker	84	81	83	13	29	18
NAADS	0	0	0	52	0	36
AFRICARE	0	0	0	36	50	40
Farmers association	0	0	0	3	21	22
Private traders/companies	16	19	17	0	0	0
Topic of training (%)*						
Potato production	60	81	70	74	100	82
Maize production	24	43	33	19	21	20
Animal production	32	19	26	19	24	20
Sample size*	**25**	**21**	**46**	**31**	**14**	**45**

* Only for those who got advice

Source: CIP survey 2005

Extension services and farmer training

Farmers are expected to acquire new information on improved varieties and agronomic practices from extension services, farmer training centers or agricultural research stations. However, only 18% of farmers in Kenya and 31% in Uganda reported having received any agricultural advice during last 12 months preceding the survey. Of those who had gotten advice, farmers in Uganda had more contacts with agricultural advisers than farmers in Kenya. In Kenya, the public extension service was the main source of advice, reaching over 80% of the few farmers who had

received advice, followed by private traders and companies (17%). In Kabale district, the National agricultural advisory service (NAADs), the privatized public extension service delivery, was most important followed by AFRICARE and the traditional extension service, while in Kisoro AFRICARE was most important followed by the public extension service. It is important to note that farmer groups were cited as sources of technical advice in Uganda and not in Kenya, while the reverse is true for private traders and companies in Kenya. Farmer field schools (FFS), were some of farmer groups supported by NARO and CIP through which farmers got agricultural advice in Uganda.

Farmer groups

Some farmers come together to form a farmers' group where members help one another and through which they enhance their farming by solving production and marketing problems. Due to economies of scale such groups are able to reduce some production and marketing costs by sharing tasks, and purchasing inputs and marketing in bulk. Such groups are also important targets by development agents who find it easy and cost effective to work with groups. In Kenya, 25% of farmers were active members of farmer groups while in Uganda 38% of farmers belonged to such groups.

Other general production and marketing constraints

High input prices, lack of cash and small land size were the general problems commonly cited by the farmers (Table 22). About 38% of farmers in Kenya said fertilizer prices, fungicide prices and labor wages have been going up affecting their incomes. Lack of cash to buy inputs was the second important problem reported to be affecting potato production in Kenya.

In Uganda, small land size was reported by 19% as a major constraint in potato production. Lack of cash and lack of clean seed were other important constraints reported by 23% and 9% of farmers in Uganda. Bacterial wilt was mentioned as a major problem mainly by farmers in Meru Central district.

Table 27. Other general problems cited by potato farmers (%).

	Kenya			Uganda		
	Meru Central	**Nyandarua**	**All**	**Kabale**	**Kisoro**	**All**
High input cost	50	31	38	11	13	11
Lack of cash/capital	12	32	24	22	27	23
Lack of clean seed	13	15	14	9	10	9
Bacterial wilt	17	2	8	6	4	5
Small land sizes	3	3	3	19	21	19
Sample size	**100**	**151**	**251**	**95**	**49**	**144**

Source: CIP survey 2005

ECONOMICS OF POTATO PRODUCTION

Yields difference between local and improved varieties

Average potato yield for the two countries remain low (7,720 kg/ha) compared to the potential yields, and vary significantly from one variety to another and from country to country (Table 28). Two season data indicated that Kenya had 56% higher mean yield and 58% higher median yield than Uganda. Although agro-ecological conditions, rainfall and other abiotic factors may be playing a major role the large differences may also be attributed to management practices, with a higher percentage of Kenyan farmers adopting improved management practices such as irrigation, fertilizer use and a higher seed rate. Mean yields for improved varieties were higher than for local varieties in both countries.

In Kenya, Tigoni had the highest yield and this could explain why adoption is increasing; in Uganda Kinigi had the highest yields and adoption is also increasing. The two varieties were perceived by farmers as high yielding. Asante which is grown in Meru Central district has high yield compared to Ngure and Kerr's pink and the reason fewer farmers were growing Asante could be that it is still being grown by early adopters and it is yet to reach the take-off stage. 'Tigoni red' which is mainly grown in Meru Central district was rated as high yielding although its mean yield was lower than that of Asante, Ngure and Kerr's pink grown in the same district. However, the median yield of Tigoni red was higher than that of Kerr's pink which it has largely replaced.

Yield gains from improved varieties

In general, the improved varieties have higher yields than local varieties (Table 28). In Kenya, Tigoni and Asante, the two most common improved varieties are among the three varieties yielding over 10t/ha, while Nyayo and Ngure, the most commonly grown local varieties have lower yields. However, Tana Kimande, one of farmers selection had also high yields of 10t/ha. On average, farmers in Kenya appear to have benefited from adopting improved yields by additional yield of 0.7t/ha. However, the economic benefits of adoption of improved varieties would be better estimated by also considering differences between the two districts with regard to variety preferences, agronomic practices and marketing conditions using multivariable analysis.

Similarly, in Uganda most of the improved varieties had higher yields compared to local varieties. Kinigi, Rutuku and Victoria are improved varieties and are regarded by farmers as high yielding. Rwangume is also among the high yielding varieties but its origin is not clear. Farmers in Uganda growing improved varieties had an additional yield of 3.9t/ha compared to those growing local varieties.

The area under improved varieties was higher in Uganda with 69.3% of area under improved varieties, while in Kenya only 35.7% was under improved varieties. The findings closely reflect earlier observation indicating predominance of local varieties in Kenya, while in Uganda improved varieties were dominant, with Victoria alone being adopted by over 50% of farmers (Kaguongo et al., 2005a; Kaguongo et al., 2005a). This could be explained by a relatively more functional seed system in Uganda compared to Kenya where there had been less efforts in improving seed system.

Table 28. Mean yields of the most commonly grown varieties in 2004-5 (kg/ha).

Kenya					**Uganda**				
	Mean	**Std**	**Median**	**n**		**Mean**	**Std**	**Median**	**n**
Tigoni	11,498	7,413	9,802	30	Kinigi	8,719	5,682	7,623	21
Tana Kimande	10,145	6,424	10,049	23	Rwangume	7,877	6,063	5,792	17
Asante	10,773	6,441	9,653	19	Rutuku	7,367	8,242	5,198	10
Komesha	9,977	9,316	6,262	12	Victoria	6,847	5,595	4,951	61
Ngure	9,505	6,282	8,302	41	Rwashakye	5,723	4,558	4,125	3
Kerr's Pink	8,385	6,263	5,979	10	Cruza	4,895	4,195	3,113	11
Nyayo	7,702	5,355	6,226	41	Kasaza	3,981	1,189	4,150	3
Tigoni red	7,427	4,934	6,417	17	Bumbamagara	2,648	2,024	2,475	21
Desiree	3,904	3,166	3,218	5					
Improved	9,713	6,415	8,713	66	Improved	6,166	4,254	4,951	98
Local	8,741	6,325	6,551	104	Local	3,426	2,473	3,267	21
All varieties*	9,009	6,422	7,620	228	All varieties	5,773	4,427	4,815	151

* Include varieties whose sources are unknown and intercropped varieties.

Source: CIP survey 2005

PROFITABILITY

Kenya

Input and labor costs

On average, cost of seed constituted the highest proportion of the total input costs followed by the cost of fertilizer[11]. The costs of inputs for improved and local varieties in Meru Central district were similar. However, costs of inputs for both types of varieties were generally higher in Meru Central district compared to Nyandarua district (Table 29). Manure cost was the lowest input cost in the two districts for the two types of varieties. In Nyandarua district, local variety had the lowest fertilizer cost among the two categories.

To cost labor, two assumptions are used: in the first family labor is treated as fixed and in the second an opportunity cost is used for family labor. This is because we appreciate how difficult it is for a farmer to quantify family labor apportioned to specific production activities and the difficulty in valuing the worth of family labor (Appendix 4). Either of the two approaches would give similar results in this analysis because the main objective is to compare profitability of improved and local varieties, and this is not very sensitive to differences in the cost of labor.

Labor costs for various production activities did not vary much between districts and variety types (Table 29). Only harvesting labor cost for improved varieties in Meru Central district was considerably lower than others, with no reason that was found. In general, the total production cost for Meru Central district was higher than that of Nyandarua district, mainly because of high costs of seeds, manure and fertilizers indicating intensive farming in Meru Central district. Production costs for 1977 for Meru Central and Nyandarua districts followed similar pattern, as observed by Durr and Lorenzl (1980).

Farmers in Meru Central districts incurred higher cost of fungicides on local varieties compared to farmers in Nyandarua districts, possibly because Meru Central farmers considered the local varieties to be more susceptible to late blight but they were willing to invest more them in disease control because of their high returns.

Returns

Gross returns were calculated using farm gate prices and output per hectare. Gross returns for Meru CentralMeru Central district were higher than that of Nyandarua district, and hence more than compensated for the higher production cost. Findings by Durr and Lorenzl (1980) also showed Meru CentralMeru Central district had higher net returns than Nyandarua district. In

[11] Opportunity cost was used for farmers using seeds from their own harvests or neighbors.

Meru CentralMeru Central district, the local varieties tend to be more profitable compared to the improved varieties mainly because the mean yield of local variety tended to be higher than mean yield of improved variety (Table 29). While Asante is high yielding the mean yield of improved varieties for the district is pulled down by the low yielding Tigoni red and Desiree (Table 28). Similarly, the mean prices of local and improved varieties are the same (Table 29) because the high prices of the predominant Ngure variety is pulled down by other local varieties such as Kerr's Pink and Komesha (Table 25). However, on average the net return to planting local varieties was higher than that of improved varieties by 284/ha per year ($142/ha per season)[12].

In Nyandarua district, a simple comparison of means suggests that improved varieties were more profitable than local varieties although the net return was lower than that of local and improved varieties in Meru Central district. Low net returns in Nyandarua district could be attributed to low prices and other marketing problems in the district. In Nyandarua district improved varieties had higher net returns than local varieties by USD 204 per year ($102/ha per season). This could be mainly because the yields and prices of improved varieties tended to be higher than that of local varieties.

When opportunity cost of family labor is used in the analysis the net returns reduce significantly and becomes negative for local varieties in Nyandarua district as shown in Table 29 below. Durr and Lorenzl (1980) also obtained negative net returns for Nyandarua district when family labor was costed. However, in Meru Central district local varieties remain more profitable than improved varieties by USD 270 per ha per year ($135/ha per season) and in Nyandarua district improved variety has higher net returns than local varieties by USD 338 per ha per year ($162/ha per season).

Variety profitability

The local varieties were most profitable with Ngure having the highest net returns followed by Meru Mugaruro and Komesha (Appendix 2). The high net returns could explain why Ngure has highly been adopted in Meru Central district. Nyayo, the most predominant variety in Nyandarua district has very low net returns explaining why farmers complained about poor market. However, these figures need to interpreted with caution as additional analysis using multivariate analysis is necessary to distinguish the effect of varietal change from other confounding factors such as differences in input use or differences in environmental factors between farmers growing improved and local varieties.

[12] Most farmers grown potatoes two times per a year.

Table 29. Costs and returns per hectare of land per season for improved and local varieties in Kenya (USD/ha).

Item	Meru Central		Nyandarua		All	
	Improved	Local	Improved	Local	Improved	Local
Input costs:						
Seed	174	164	84	68	132	117
Manure	58	31	2	6	32	18
Fertilizer	137	119	114	56	127	89
Fungicides	36	43	35	10	36	28
Total input cost	405	357	235	140	328	252
Labor cost (Hired only):						
Land preparation, planting and weeding	60	76	72	74	65	75
Manure and fertilizer application	9	8	4	6	7	7
Fungicide application	4	5	4	3	4	4
Harvesting	28	40	59	54	42	48
Total cost of hired labor	101	128	140	136	117	132
Labor cost (hired and opportunity cost of family labor)						
Land preparation, planting and weeding	92	115	145	170	113	134
Manure and fertilizer application	26	24	23	35	24	30
Fungicide application	12	14	9	8	11	11
Harvesting	39	51	113	139	72	92
Total cost of hired and family labor	169	204	290	352	219	267
Mean yield	7,686	8,971	12,299	8,492	9,713	8,741
Price (USD/t)	95	95	44	40	72	69
Gross return	730	852	541	340	699	603
Net returns (hired labor only)	225	367	166	64	254	219
Net returns (hired & family labor)	156	291	16	-153	152	84
Sample size	**37**	**56**	**23**	**51**	**60**	**107**

Source: CIP survey 2005

Uganda

Input and labor costs

Cost of seed forms the single most important cost of potato production in Uganda, constituting over 60% of total production cost (Table 30)[13]. At the same time seed cost of improved varieties were higher compared to that of local varieties. Costs of manure and fertilizer were negligible when compared to those of Kenyan farmers. The amount spent on fungicides for improved varieties was higher than for local varieties in the two districts. This is consistent with farmers' perceptions that Victoria is highly susceptible to late blight.

When only hired labor is considered, total labor cost for land preparation, planting and weeding for improved varieties were generally higher than that for local varieties, because the more commercially oriented larger scale potato farmers tended to use the more profitable improved varieties.

Returns

Gross return was calculated using farm gate prices and output per hectare. Gross returns for improved varieties were higher than for local varieties in the two district of Uganda mainly because they are high yielding and they fetched higher prices. Hence improved varieties are more profitable than local varieties (Table 30). Farmers in Kabale district obtained extra USD 254 per ha ($127/ha per season) from growing improved varieties while Kisoro farmers obtained an extra USD 416 per ha ($208/ha per season) from growing improved verities. The entire Uganda sample farmers growing improved varieties obtained an extra USD 358 per ha ($179/ha per season) compared to those growing local varieties.

Including opportunity cost of family labor in the analysis reduced the net returns of local varieties significantly but marginally affected the net returns for improved varieties, indicating that local varieties mainly used family labor, while production of improved varieties highly depended on hired labor. Improved varieties remained more profitable than local varieties by USD 400/ha per year ($200/ha per season) in Kabale district and USD 386/ha per year in Kisoro district. The entire Uganda sample farmers obtained an average USD 408 /ha (per season) extra from growing improved varieties, although as was noted above additional analysis is needed to separate the effect of varietal change from other confounding factors.

[13] Opportunity cost was used for farmers using seeds from their harvests or neighbors.

Variety profitability

Apart from Marirahinda which had negative net returns all other local varieties were more profitable than Bumbamagara the most common local variety (Appendix 2). The findings indicated that Victoria, the most predominant variety is more profitable than Rutuku and Cruza two of improved varieties which Victoria seems to have replaced.

Table 30. Costs and returns per hectare of land per season for improved and local varieties in Uganda (USD/ha).

Item	Kabale		Kisoro		All	
	Improved	Local	Improved	Local	Improved	Local
Input costs:						
Seed	174	90	188	57	179	72
Manure	4	0	5	4	4	2
Fertilizer	1	0	18	0	7	0
Fungicides	33	6	27	1	30	4
Total input cost	212	96	238	62	220	78
Labor cost (Hired only):						
Land preparation, planting and weeding	40	20	44	15	41	17
Manure and fertilizer application	3	0	6	0	4	0
Fungicide application	2	4	4	0	3	3
Harvesting	15	10	32	7	21	8
Total cost of hired labor	60	34	86	22	69	28
Labor cost (hired and opportunity cost of family labor)						
Land preparation, planting and weeding	83	122	101	68	90	91
Manure and fertilizer application	4	0	13	3	7	1
Fungicide application	15	13	16	3	15	8
Harvesting	38	52	47	24	41	37
Total cost of hired and family labor	140	187	177	98	153	137
Mean yield	5,662	3,293	7,207	2,813	6,166	3,033
Price (USD/t)	98	87	86	61	94	72
Gross return	555	286	620	172	580	218
Net returns (hired labor only)	283	156	296	88	291	112
Net returns (hired & family labor)	203	3	205	12	207	3
Sample size	**65**	**10**	**38**	**13**	**103**	**23**

Source: CIP survey 2005

Conclusions and Recommendations

Potato farmers in Kenya and Uganda in this study had a lot in common but dissimilarities did exist in socio-economic characteristics, asset ownership and agronomic practices. Kenyan farmers owned slightly more livestock, equipment and land and a higher proportion of household heads had completed primary education compared to their Ugandan counterparts. Mean cultivated area was the same for the two countries, although Kenyan farmers had slightly higher area under potato production and more land under irrigation.

Farmers in the two countries were also faced with different consumer preferences that affected choices of varieties grown. CIP 381381.20 has had wider diffusion in Uganda (under the released name Victoria) compared to Kenya (under the name Asante) mainly driven by clear preferences for red-skinned varieties throughout Uganda compared to Kenya (where preferences for white-skinned and red-skinned varieties vary considerably among major growing areas).

Market demand emerged as the most important criterion underlying variety selection. The second most important criterion for farmers was yield, followed by the fit of the variety in their cropping system, in terms of earliness, and then taste was the next important attribute. Although disease resistance is an important attributes it plays a limited role in adoption of varieties with high market demand. For example, in Meru Central district the predominant variety was relatively more susceptible to late blight than other available varieties. Farmers were cognizant of this drawback, but continue producing it because it fetched a higher price and fungicides were available to control the problem. Tigoni, a high yielding white skinned variety, has had limited adoption in Meru Central district but was well accepted in Nyandarua district where consumer preferences concerning skin color differ from those in Meru. This study therefore stresses the need to orient goals of CIP and its partners to selecting market and farmer preferred potato varieties, that are adapted to local cropping system and which carry useful late blight resistance levels.

Several varieties continued to be grown for home consumption despite their low market value due to taste and early maturity traits. For example, the second most important variety in Uganda, Bumbamagara, was considered less marketable but more tasty and early maturing than other varieties.

While disease resistance is clearly an underlying driver of yield, no farmer specifically mentioned late-blight tolerant varieties as a method for late-blight control. The majority of farmers in both countries used fungicides to control late blight. Although the predominant varieties in the two countries, Nyayo and Ngure in Kenya and Victoria in Uganda were rated poorly in disease

tolerance they faced high demand in their respective areas of production. However, the degree to which a variety was considered susceptible to late-blight depends on the range of late-blight resistant materials in the area. Interestingly, CIP 381381.20 (Asante in Kenya and Victoria in Uganda) was regarded as late blight resistant in Kenya while in Uganda it was rated as susceptible to the disease. A plausible explanation of this difference is that farmers in Uganda were used to varieties such as Rutuku and Cruza which have high resistance to late blight.

Thus, farmers appeared to underestimate the actual benefits of adopting late-blight resistant varieties in both countries. This is due in part to the cost of controlling late blight on susceptible varieties being low compared to the cost of seed and other inputs. Most farmers were unaware of the potential economic losses incurred through incorrect fungicide application and the health risk posed by use of fungicides. A study relating late blight prevalence and farmers use of fungicides to quantify the economic losses incurred by farmers and possible health risk caused by improper method of fungicide use is therefore recommended.

Distinct differences in agronomic practices in the two countries existed. In particular, Kenyan farmers used higher seed rates and more intense fertilizer applications than farmers in Uganda. This explains the higher yields found for Kenyan farmers compared to Ugandan farmers, but lower profitability due to high production cost-an indication that Kenyan farmers could have been operating at economically sub-optimal levels. Furthermore, the almost similar multiplication ratio of 6 for the two countries can not explain the relatively intensive husbandry in Kenya. This may mean that the predominant varieties grown in Kenya are of low genetic potential and farmer stand to gain substantially by adopting higher yielding varieties. However, input and output market conditions could be contributing to most of the imbalances. Further in-depth market analysis is essential for untangling the contribution of each underlying factor. More in-depth analysis should also demonstrate whether farmers in Uganda stand to gain by intensifying management of the crop.

Self supply and neighbor supply were the predominant sources of seed for potato farmers in both Kenya and Uganda. The performance or quality of the seeds from these sources was doubtful leading to reduced yields. Access to certified seed is limited due to lack of supply and high per unit cost. Past efforts in development of seed system have concentrated on improved seed production by government parastatals, while current interventions in seed potato systems are concentrated on developing specialized seed multipliers. However, multiple strategies, including greater involvement of the private sector, are clearly needed to address bottlenecks in potato seed production. These strategies should include interventions to improve the quality of

the self and neighbor supply seed as they are likely to remain the most common source of seed for smallholders, at least in the medium term.

The majority of farmers from both countries sell their ware potato on harvesting leading to glut periods and depressed prices. Increased potato storage use could even out supply over the season, thus reducing price fluctuations. However, construction of storage facilities for larger farmers may require credit facilities and additional analysis of price seasonality and storage losses is needed to assess the financial viability of these facilities.

The findings clearly demonstrate that profitability of potato production in Kenya varies considerably between regions and among varieties. In Meru Central district, farmers with improved varieties had lower net returns than those growing local varieties while the opposite was true in Nyandarua district. Districts with production and marketing characteristics similar to those of Nyandarua district are expected to have similar benefits from adoption of improved varieties. A note of caution is necessary in interpreting these results as additional analysis using multivariate analysis is necessary to distinguish the effect of varietal change from other confounding factors such as differences in input use or differences in environmental factors between farmers growing improved and local varieties. Substantial improvement in profitability, however, depends on improved market conditions, including more efficient linkages between producers, traders, and consumers.

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Appendix 1. Potato production for Kenya and Uganda: 1990-2005.

Year	Kenya			Uganda		
	Area Harvested (Ha)	Production (Mt)	Yield (t/ha)	Area Harvested (Ha)	Production (Mt)	Yield (t/ha)
1990	87,890	779,190	8.87	32,000	224,000	7.00
1991	87,144	987,828	11.34	35,334	254,000	7.19
1992	68,037	632,572	9.30	37,000	268,000	7.24
1993	55,675	654,123	11.75	40,000	320,000	8.00
1994	83,000	806,000	9.71	44,000	368,000	8.36
1995	96,168	928,744	9.66	50,000	402,000	8.04
1996	98,000	744,000	7.59	53,000	318,000	6.00
1997	118,596	835,208	7.04	56,000	360,000	6.43
1998	90,418	679,738	7.52	60,000	384,000	6.40
1999	114,602	1,047,572	9.14	64,000	449,000	7.02
2000	108,516	670,303	6.18	68,000	478,000	7.03
2001	121,496	1,112,849	9.16	73,000	508,000	6.96
2002	111,728	861,566	7.71	78,000	546,000	7.00
2003	126,490	1,223,531	9.67	80,000	557,000	6.96
2004	128,484	1,084,412	8.44	83,000	573,000	6.90
2005	120,842	980,163	8.11	86,000	585,000	6.80

Source: FAO[14]

[14] http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567; Dated May 2007

Appendix 2. Production details of commonly grown varieties in Kenya and Uganda (per ha).

Variety	Input cost[15]				Labor				Price[16]		Gross return	Net return	n
	Seed	Manure	Fertilizer	Fungicides	Land preparation and weeding	Fertilizer and Manure application	Fungicides application	Harvesting	Seed	Ware			
Kenya													
Tigoni	87	11	113	37	70	5	4	58	49	46	529	155	25
Asante	198	47	170	42	67	11	3	33	109	94	840	257	18
Nyayo	63	11	49	7	71	6	1	55	40	38	293	37	23
Tana Kimande	86	25	102	33	60	2	4	58	55	55	558	189	20
Ngure	177	38	121	47	78	9	6	39	101	97	922	411	43
Kerr's Pink	105	60	130	31	79	7	5	36	73	68	570	154	9
Tigoni red	145	33	108	27	55	6	4	23	114	79	706	286	17
Komesha	118	14	84	24	70	3	3	44	79	75	748	392	12
Desiree	149	29	100	8	76	11	7	40	80	80	312	-92	5
Zangi	123	57	110	28	68	5	1	32	72	72	607	210	5
Meru Mugaruro	98	0	74	24	25	5	3	29	50	50	565	311	7
Kihoro	64	44	118	14	33	5	0	20	37	37	264	-10	2

[15] Only hired labour is considered.
[16] Per ton.

Appendix 2. Production details of commonly grown varieties in Kenya and Uganda (per ha) (Continue).

Variety	Input cost[17]				Labor				Price[18]		Gross return	Net return	n
	Seed	Manure	Fertilizer	Fungicides	Land preparation and weeding	Fertilizer and Manure application	Fungicides application	Harvesting	Seed	Ware			
Uganda													
Victoria	174	5	1	34	45	3	2	19	133	98	671	286	61
Bumbamagara	63	6	0	2	14	0	9	8	96	71	188	90	20
Cruza	111	0	0	19	41	10	3	24	124	74	362	152	11
Rwashakye	130	1	0	13	38	0	0	13	128	79	452	258	3
Kinigi	214	2	31	22	44	5	4	34	167	89	776	341	22
Rutuku	157	0	0	43	14	0	2	5	170	98	722	251	8
Kasaza	223	0	0	54	59	0	0	7	70	70	279	-65	3
Makerere	62	60	0		0	0	0	0	79	79	258	168	3
Rwangume	127	0	0	64	35	0	5	33	84	81	638	373	18
Marirahinda	36	0	0	0	0	0	0	26	53	53	58	-5	3

Source: CIP survey 2005

[17] Only hired labour is considered.
[18] Per ton.

Appendix 3. Production of pre-basic seed during 1993-94 in Uganda (kg).

Variety	Ex-Stem cutting	Ex-clonal selection	Total produced	Proportion
Kabale	2,222	6,235	8,457	26.2
Victoria	1,709	3,642	5,351	16.6
Rutuku	240	3,985	4,225	13.1
Kisoro	1,151	2,503	3,654	11.3
Cruza	743	2,713	3,456	10.7
Malirahinda	586	2,713	3,299	10.2
Sangema	672	2,523	3,195	9.9
Kabanyolo	225	400	625	2.0
Total			**32,262**	**100**

Source: Sikka, 1994 and UNPRDP, 1994

Appendix 4. Details of Data Analyses.

I. Currencies

- One US dollar was exchanging for Uganda shillings (Ushs) 1,725 in 2005.
- One US dollar was exchanging for Kenya shilling (Kshs) 73 in 2005.

II. Variety and landraces classification

Variety names keep changing from one district to another and from one country to another. For example, the variety referred to as Asante in Kenya is called Victoria in Uganda. The variety called Tigoni in Meru Central district is red in color and has different characteristics from the one officially known as Tigoni in Kenya which is white. Hence, in this study we refer the variety found in Meru Central as Tigoni red. Another example is where Rutuku is referred to as Rusina in Bukinda sub-county, Kabale district.
The following are local names and corresponding official names of some of varieties with double names during the survey:

Local name	Official name	District	Percent of farmers
Kenya			
Tigoni	'Tigoni red'	Meru Central	30
Meru	Kerr's Pink	Meru Central	20
Mweri Imwe	Kerr's Pink	Nyahururu	5
Tana Kalamu	Roslin Tana	Nyahururu	1
Tana Gathundo	Tana Kimande	Nyahururu	1
Uganda			
Rusina	Rutuku	Kabale	12
Takubura	Rutuku	Kabale	4
Romano	Dutch Robijn	Meru Central	1
Point 20	Victoria	Kabale	1
Maali	Marirahinda	Kabale	1

Source: Discussions with Mr. Peter. Kinyae of KARI, Kenya and Mr. Innocent Uzatunga of NARO Uganda.

III. Labor costs

One way of valuing family labor is to use opportunity cost of labor. However, in some cases there are no alternative jobs for farmers and their children in rural areas and quantifying the labor provided by family member is rarely accurate because they attend to various household and farm chores at the same time. There for this study treated family labor as fixed and assumed it will be accounted together with returns to management in net returns.

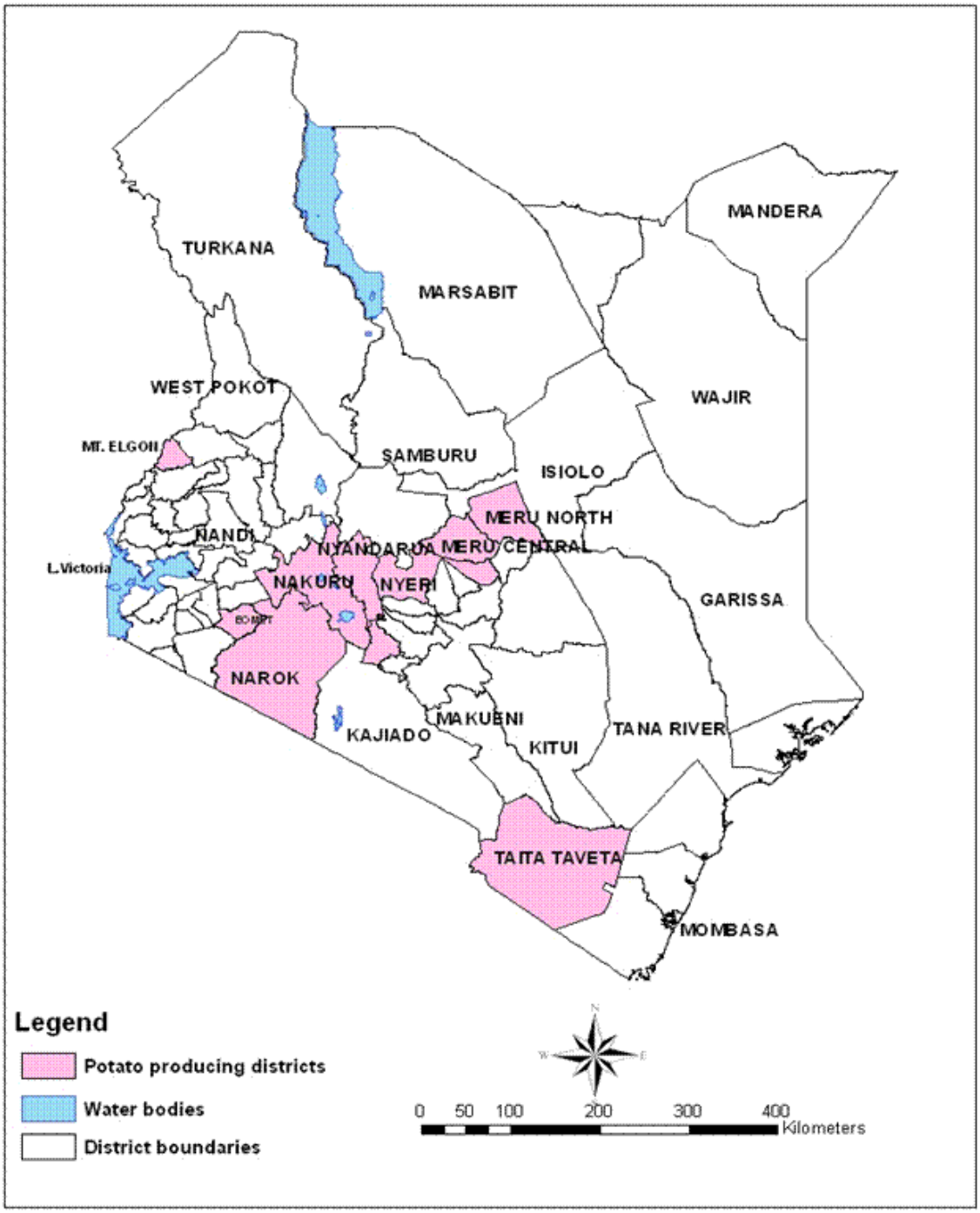
IV. Seed costs

Farmers had a tendency of exaggerating seed prices although most of them were not ready to pay the market value of clean seed. Ware prices were used when calculating net returns for farmers reporting self supply and neighbours as sources of seeds. Prices were taken as given for farmers reporting sources of seed to be commercial seed grower, farmers association and national research stations.

V. Weights of Farm Yard Manure (FYM)

Estimation of amount of FYM used was difficult because of varying degree of dryness and also different containers used for carrying manure to the fields. Weight of manure was adjusted using estimates from Smallholder Dairy Project division in International Livestock Research Institute (ILRI).

Appendix 5. Map of Kenya showing potato producing districts**.**



Appendix 6. Map of Uganda showing potato producing districts.

Appendix 7. Survey questionnaire – Uganda

A: Household Characteristics
B: Farm Assets
C: Crop production
D: Potato production
E: Potato marketing and utilization
F: Credit and information
G: Household Income

ECONOMIC IMPACT ASSESSMENT OF CIP- DERIVED LATE BLIGHT-TOLERANT POTATO VARIETIES IN UGANDA

Farmer number_____ (_____) Date___/___/____

Farmer's name_____

District_____ County _____ Sub-county_____ Parish_____ village_____
[DDLLVIFNO]

Enumerator's name_____ Entered by_____

1st check by _____ Date___/___/___ initial
2nd check by _____ Date___/___/___ initial

[RESPNAME] Respondent's name _____

A: Household Characteristics

1a. **[MARITAL]** What is the marital status of the household head?

1= Married and living with spouse
2= Married and heading the household while spouse is away working
3= Never married
4= Divorced/separated
5= Widow/widower
6= Other (specify)_____

1b. Please provide the details of household members and workers (starting with respondent)

Name	Gender **[GENDER]**	Age **[AGE]**	Education level **[EDUCTN]**	Relation to the hh head **[RELTION]**	Residence on the farm **[RESIDCE]**	Labour participation **[LABPART]**
1.Respondent						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						

CODES

Gender
1. Male
2. Female

Education level
1. None
2. Primary (≤4 years)
3. Primary (>4 years)
4. Secondary
5. Post-secondary
6. Adult education

Relationship to the household head
1. Household head
2. Spouse
3. Child
4. Parent
5. Worker
6. Other (specify)_____

Residence on the farm
1. Full time
2. Part time
3. None
4. Other (specify)_____

Labour participation (during production season)
1. Full time worker
2. Part time worker
3. Not a worker
4. Other (specify)_____

B: Farm Assets

2a. **[FARMSIZE]** What is the total size of your land _____ (acres)

b. **[RENTLAND]** What is the total rented land_____(acres) c. **[BORRLAND]** What is total borrowed land _____(acres)

d. **[CULTLAND]** What is the total cultivated land?_____ (in acres)

e. Indicate number of livestock owned

Cattle **[CATTLE]**	Goats **[GOATS]**	Sheep **[SHEEP]**	Poultry **[POULTRY]**	Pigs **[PIGS]**	Other (specify)_____

f. In the following table, please indicate the number of listed items owned.

Do you have?	No. owned
1. Bicycle **[BICYNO]**	
2. Motorcycle**[MOTCYNO]**	
3. Car or Truck**[CARNO]**	
4. Tractor **[TRACNO]**	
5. TV **[TVNO]**	
6. Refrigerator **[REFNO]**	
7. Cell phone **[PHONENO]**	
8. Ox- plough **[OXPLNO]**	
9. Ox/donkey- cart **[OXCTNO]**	
10. Other (specify)_____	

C. Crop production

3 a. What is the total area grown each type of crop last season

Crop **[CROP]**	Acres planted **[ACRES]**

Codes
Crops grown
1. Potatoes
2. Maize
3. Beans
4. Wheat
5. Tea
6. Coffee
7. Sorghum
8. Millet
9. Sweet potato
10. Bananas
11. Cassava
12. Peas
13. Vegetables
14. Other (specify)_____

3b. **[IRRIGT]** Do you use irrigation? 1= Yes 2= No

If yes, what are the three main crops on irrigation and what type of irrigation? (**use crop codes in qn. 3 above**)

Irrigated crop **[IRRCROP1]**	Crop area **[IRRAREA]** (acres)	Type of irrigation **[IRRTYP]**

Codes
1. Surface
2. Sprinkler
3. Drip
4. Hand watering
5. Others (specify)_____

D. Potato production

4a. **[YRSGWP]** Years farmer has grown potatoes_____

b. **[GRWTIMES]** How many times do you grow potatoes per year?_____

5a. How many plots of potatoes did you grow in the last two seasons?

Year	Season	Number of plots
2004 (Sep-Jan)	2nd **[PPT204]**	
2005 (Feb-June)	1st **[PPT104]**	
2005 (Jun-Sep)	Off-season	

(Draw a rough sketch of the plots in the farm)

5b. For each season please give details of varieties grown, acreage and production level of each potato plot

Year & season **[YRSN]**	Plot # **[PPNO]**	Variety grown **[VTYGRN]**	Acres grown **[GNACR]**	Source of seed **[SEEDSC]**	Seed rate				Production			
					Seed size **[sdsze]**	Seed price at planting **[SDPC]**	Amount **[SDQT]**	Unit **[SDUNT]**	Amount **[PDQTY]**	Unit **[PDUNT]**	Unit price **[UNTP]**	Kg equivalent **[KGEQV]**
2004												
Season 2												
2005												
Season 1												
2005												
Off-season												

Codes

Varieties grown
1. Victoria
2. Nakpot1
3. Nakpot5
4. Bumbamagara
5. Cruza
6. Rwashakye
7. Chinigi
8. Rusina/Rutuku
9. Other (specify)_____

Seed source
1. Own
2. Neighbour (untrained)
3. Market trader
4. Commercial seed grower/ trained farmer
5. Seed grower association(specify)_____
6. Other (specify)_____

Seed sizes
1. Small
2. Medium
3. Large
4. Other (specify)_____

Unit of production & seed rate
1. Kg
2. 110 kg bag
3. 120-140 kg bags
4. 150-200
5. Pail/ bucket/busket
6. Other (specify)_____

6a. For each variety grown indicate the **good and bad** variety qualities if any, starting with the most important:

Variety **[VTYPBM]**	**Good qualities**			**Bad qualities**		
	Most important **[PRDADV1]**	2nd important **[PRDPADV2]**	3rd Important **[PRDADV3]**	Most important **[PRDPBM1]**	2nd important **[PRDPBM2]**	3rd Important **[PRDPBM3]**

Codes

Varieties grown
1 Victoria
2 Nakpot1
3 Nakpot5
4 Bumbamagara
5 Cruza
6 Rwashakye
7 Chinigi
8 Rusina/Rutuku
9 Other (specify)_____

Good qualities
1. None
2. White skin colour
3. Pink/red skin colour
4. High yielding
5. Tolerant to Late blight
6. Tolerant to Bacteria wilt
7. Early maturing
8. Store for long without sprouting
9. Sprout very fast/ early for planting
10. Big tubers
11. Drought tolerant/ resistant
12. Small seed sizes easily available
13. Does not green easily
14. Des not rot easily when scratched
15. Clean seeds are easily available
16. High prices
17. Highly marketable
18. Very tasty
19. Good for chips
20. Good for mashing
21. Other (specify)_____

Bad qualities
1. None
2. White skin colour
3. Pink/red skin colour
4. Low yielding
5. Susceptible to Late blight
6. Susceptible to Bacteria wilt
7. Late maturing
8. Sprout very fast/ early for storage
9. Take very long to sprout for planting
10. Small tubers
11. Easily affected by drought
12. Lack of seeds due to big tubers
13. Greens very fast
14. Rots easily when scratched
15. No clean seed available
16. Low prices
17. Low marketability
18. Not tasty
19. Not good for chips
20. Not good for mashing
21. Other (specify)_____

6b. For each of the variety grown, when was the first time to grow the variety and what was the seed source?

Variety grown **[VTYGRN]**	Year first grown **[GRNFST]**	Seed source first time **[SEEDFST]**	**Do you renew seeds? 1= Yes 2=No If yes,**	
			After how many seasons? [RENSD]	**What was the last seed source? [SDSC]**

Codes

Varieties grown
1 Victoria
2 Nakpot1
3 Nakpot5
4 Bumbamagara
5 Cruza
6 Rwashakye
7 Chinigi
8 Rusina/Rutuku
9 Other (specify)_____

Seed source
1. Kalengyere
2. Neighbour (untrained)
3. Market trader (unclean)
4. Commercial seed grower/ trained farmer
5. MOA extension staff
6. Seed grower association(specify)_____
7. Other (specify)_____

6c. **[PRODSD]** What is your principal method of producing seed for your own use?
a) I grow seed in a separate seed plot
b) I select the best looking plants and select their tubers for seed (positive selection)
c) I sort out the small tubers from the overall harvest
d) Other (Specify)_____

7a. **[OLDVTY1]** Before you adopted the variety(s) listed above, what old varieties did you grow and what were the main reasons for abandoning them?

Variety abandoned [ABANDVRT1] Reasons for abandoning **[ABANDRSN!]**

i. _____ _____

ii_____ _____

ii_____ _____

7b. **[SEEDPRB1]** Do you have problems getting high quality seeds? 1=Yes 2= No

If yes, what are the problems?

i. _____

ii. _____

iii. _____

7c. **[PFTRAIT1]** What should be the priorities for potato breeding for future varieties (what traits)**?**

iv. _____

v. _____

vi. _____

vii. _____

viii. _____

8a. **[APPLYMAN]** Did you apply manure to potatoes last season? 1=Yes 2= No

8b. **[APPFERT]** Did you apply chemical fertilizer during last growing season? 1= Yes, 2=No

8c. Please, give details of manure and fertilizers used in potato production last growing season **(refer page 3 above for plot no).**

Plot # **[PLOTNO]**	Total manure applied (kg) **[MANU]**	Type 1[FTTYP1]_____			Type 2[FTTYP2]_____			Type 3[FTTYP13]_____		
		Time appl. (in days) **[FRT1TM]**	Amount (Kg) **[FRT1AMT]**	Total cost (Shs) **[FRT1CST]**	Time appl. (in days) **[FRT2TM]**	Amount (Kg) **[FRT2AMT]**	Total cost (Shs) **[FRT2CST]**	Time appl. (in days) **[FRT3TM]**	Amount (Kg) **[FRT3AMT]**	Total cost (Shs) **[FRT3CST]**

8d. **[MANCST]** Price of manure if used (Sh/ton) _____

8e. **[FERTPROB]** Do you have any problem with fertilizers used? 1= Yes 2= No

If yes, indicate fertilizer type and type of problem (s)

Fertilizer type **[PRBFERT1]** Problem type **[FERTPRB1]**

i. _____ _____

ii. _____ _____

iii. _____ _____

iv._____ _____

8f. **[NOFERT1]** If fertilizer is not used, what are the reasons for not using fertilizer

i._____

ii._____

9. **[LBPRB]** Is Late Blight a problem to the farmer in potato production? 1= Yes 2= No

a. **[LBTVRT]** Is farmer aware of variety differences in level of tolerance to Late Blight?

1=Yes 2= No

i. **If yes,** rank known varieties according to level of tolerance (one for the most tolerant)

Variety [RNKSSC1] Rank **[RANK1]**

i._____ _____

ii._____ _____

iii_____ _____

iv_____ _____

b. **[LBCAUS]** Does the farmer know what causes **Late blight** or what aggravates the disease?

1= Yes 2= No

If yes,

i. **[AGENT]]**What is the causal agent?_____

ii. **[AGGRVT]** Give conditions that aggravates it

1. _____

2. _____

c. What methods do farmers use to control Late Bright in potato varieties **[LBCONT1]**?

i._____ ii._____iii_____

d. **If farmer uses fungicide spray to control late blight,** what determines when to start applying?

_____

_____

10. Please, give details of fungicides used in potato production during last growing season

Plot # **[PLOTNO]** **(refer above)**	Variety grown **[VRTGN]**	Number of times fungicide was applied **[FGTM]**	Fungicide Type 1 **[FGTYP1]** _____			Fungicide Type 2**[FGTYP2]** _____			Name other chemical applied if any**[OTHCHE]**_____		
			Time of appl. (in days) **[FG1TM]**	Amount applied **[FG1AMT]**	Total cost (Shs) **[FG1CST]**	Time of appl. (in days) **[FG2TM]**	Amount applied **[FG2AMT]**	Total cost (Shs) **[FG2CST]**	Purpose of appln. **[]**	Amount applied	Total cost

11. For the varieties grown give details of labor used for potato production in last growing season for the largest plots.

Operation	Number of man days of male family labor	Number of man days of female family labor	Number of man days of hired male labor	Male labor wage (Sh/day)	Number of man days of hired female labor	Female labor wage (Sh/day)	Cost if using ox-plough/ tractor / other (Sh)
Plot no._____							
Variety grown_____							
Field preparation							
Applying manure							
Seeding							
Weeding							
Applying fertilizers							
Applying chemicals							
Harvesting							
Plot no._____							
Variety grown_____							
Field preparation							
Applying manure							
Seeding							
Weeding							
Applying fertilizers							
Applying chemicals							
Harvesting							

12. Were any other inputs used in potato production? 1= yes 2=No

    i. **If Yes,** what kind of input? _____

    ii. What was total cost of this input (sh/acre)? _____

13. **Please, i**ndicate what crops were grown before potatoes in the plots above and what crop is grown this season

Plot #	Two seasons before last season **[RTN041]**	One season before last season **[RTN041]**	This season **[RTN041]**

E. Potato marketing and utilization

14. **[STORESD]** Do you store potato seeds**]?** 1= yes 2= No

If yes,

a. **[STOREPD]** For how long do you store seeds? _____days

b. **[STRTYPE]** Where are potato seeds stored**?**
   1. Dark store
   2. Lit store
   3. Field
   4. Dark space in the house
   5. In light in the house
   6. Other (specify)_____

c. **[STRCONT]** In what type of container are the potato seed stored?
   1. Gunny bags
   2. Shelves
   3. Heaped
   4. Spread on the floor
   5. Other (specify) _____

d. **[SPROUT]** What do you do to ensure potatoes sprout in time?
   1. Use a pit
   2. Put in bags
   3. Wait
   4. Put in a warm place
   5. Use chemicals
   6. Other (specify)_____

15. **[SOLDPOT]** Have you sold potatoes at any time in the last 2 seasons? 1 = Yes 2 = No

16. Please, give details of marketing and utilization for each of the varieties grown in the last two seasons

Year and season **[UTLSN]**	Variety **[UTLVTY]**	To whom did you sell? **[SLPLC]**	Amount sold **[QTYSLD]**	Selling Unit **[SLUNT]**	Price per unit sold (Shs) **[SLPRCE]**	Amount in Kg used for Home consumption **[HOMEUSE]**	Amount in kg Kept for seed **[SEEDKPT]**	Waste or fed to animals (kg) **[WASTFED]**	Who makes decision to sell? **[DCSALE]**
2004									
Season 2									
2005									
Season 1									
2005									
Off- season									

Codes

Varieties grown
1. Victoria
2. Nakpot1
3. Nakpot5
4. Bumbamagara
5. Cruza
6. Rwashakye
7. Chinigi
8. Rusina/Rutuku
9. Other (specify)_____

To whom potato was sold
1. Village market
2. District/ capital market
3. Middlemen at farm gate
4. NGOs
5. Farmers cooperative/ group
6. Private trader (specify)_____
7. Other (specify)_____

Unit of sale
1. Kg
2. 110 kg bag
3. 120-140 kg bags
4. 150-200
5. Pail/ bucket
6. Other (specify)_____

Decision on selling
1. Wife
2. Husband
3. Both
4. Others (specify)_____

17. **[MKTPRB]** Did you have any marketing problems? 1 = Yes 2 = No

18. **If yes,** indicate the major marketing problems, starting with the most important

Year and season **[UTLSSN]**	Variety **[UTLVTY]**	Marketing problems		
		Most important **[MKTPBM1]**	2nd important **[MKTPBM2]**	3rd important **[MKTPBM3]**
2004				
Season 2				
2005				
Season 1				

Codes

Variety sold
1. Victoria
2. Nakpot1
3. Nakpot5
4. Bumbamagara
5. Cruza
6. Rwashakye
7. Chinigi
8. Rusina/Rutuku
9. Other (specify)_____

Marketing problems
1. None
2. Lack of buyers
3. Low prices
4. Long distance to market
5. Lack of market
6. Other (specify)____

For those who did not sell potatoes in the last two season (refer to qn 15)

19. **[RSNNSELL]** Why have you not sold any of the potato varieties you grow in the two last seasons?
1= Lack of buyers
2= Low prices
3= Produced enough for the family only
4= Other (specify)_____

-888= Not applicable

F. Credit and information

20. **[TECHADV]** From where did you get technical advice about farming in the last one year?
    1 = Agricultural extension worker
    2 = Private input supplier
    3 = Vegetable trader
    4 = Other farmers
    5 = Mass media (Television, Radio, Newspaper, etc)
    6 = Farmer Field School (FFS)
    7 = Other source (mention): ……..

21. **[EXTTIMES]** How many times did you participate in **agricultural extension and training activities** in last one year? _____ times

    a. What were the topics of these training activities and who gave the training?

    Topic **[EXTTOP1]** Who gave the training **[TRAINR]**

    1. _____ _____

    2. _____ _____

    3. _____ _____

    4._____ _____

22. **[ACTMEMB]** Are you an active member of a village organization or farmer group? 1= Yes 2=No.

    a. **If yes,** What kind of organization/group?_____

23. **[NETINCO]** Do you know how to calculate net returns from potato production? 1= Yes 2=No.

    a. **If yes,**
    b. Do you calculate net profit from potato production? 1= Yes 2=No.

    c. From who did you learn how to do it?_____

24. Have you receive any agricultural credit for farm production in the last 2 years? 1= Yes 2=No.

If yes, explain in the following table:

Source of credit	When given	Amount of loan (Shillings)	Duration of the loan (months)	Interest rate (%/month)	Kind of guarantee	Purpose (what commodity)

G. Household Income

25. How much income did you or anyone in your household earn over the past 12 months?

Please, give the amount received from each source

Source	Gross Income or Value (Shillings)
1 Total Crop sales **(refer to section C above)**	
2 Sales of animals or animal products	
3 Other on-farm income (Specify)	
4 Salaries, gifts and remittances	
5 Other non-farm income (Specify)	

26a. What are the other potato production constraints facing farmers in the village and have not been mentioned above?

26b. Give suggestion on how to overcome these constraints

THANK YOU

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The International Potato Center (CIP) will contribute to reducing poverty and hunger; improving human health; developing resilient, sustainable rural and urban livelihood systems; and improving access to the benefits of new and appropriate knowledge and technologies. CIP, a World Center, will address these challenges by convening and conducting research and supporting partnerships on root and tuber crops and on natural resources management in mountain systems and other less-favored areas where CIP can contribute to the achievement of healthy and sustainable human development.

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International Potato Center

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