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INFLUENCE OF MARKET AND FARMER PREFERENCES ON POTATO VARIETY ADOPTION

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ABSTRACT

This study assess adoption of improved potato varieties by farmers using a survey conducted in November 2005 among 251 randomly selected households in major potato producing areas in Kenya (Meru and Nyandarua districts) and Uganda (Kabale and Kisoro districts).

The study shows that variety adoption was influenced in the first place by market preferences. Secondly the fit within the production system is important, while high late blight resistance is appreciated by farmers, but it is not the single most important trait farmers consider in variety choice. This stresses on 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.

The outcomes of the study emphasize that focussing on a single trait, such as late blight resistance, will not result in farmer preferred varieties. It also stresses on the importance of promoting improved varieties amongst consumers, traders and producers, rather than on the producer side alone.
Key words: Adoption, improved varieties, late blight resistance, market and farmer preference.

INTRODUCTION

Potato (*Solanum tuberosum*) is a staple food for many rural and urban families of East Africa. According to 2005 FAO statistics, Ugandan potato production of about 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. This is low compared to the 25t/ ha attainable by progressive farmers under rain fed conditions (Kinyae *et al*, 2004; Low, 2000). 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.

Late blight caused by the fungus *Phytophthora infestans* can devastate a potato crop (Stewart and Bradshaw, 2000). 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). 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). Nyankanga et al (2004) estimated an overwhelming 98% of potato farmers in Meru district in Kenya rely on fungicides to protect their potato crop against late blight, with an average of 5 sprays per season. In Uganda also, late blight has remained an important constraint affecting level of production across districts (Low, 2000; Akimanzi 1982).

Over the years National Research Stations (NARS) in Kenya and Uganda, in collaboration with International Potato Centre (CIP) and Regional Potato and Sweetpotato Improvement Program for Eastern and Central Africa (PRAPACE) have invested in development and promotion of high yielding and late blight resistant varieties. These improved varieties[1] have been released by the

[1] Varieties developed and promoted by NARS since 1970 that are considered to be superior in qualities

NARS with the aim of replacing the lowly performing local varieties[2]. This study aims at documenting the level of adoption of improved potato varieties and factors affecting adoption. CIP and its partners hope to draw lessons from this study with regard to the effectiveness of variety development and promotion strategies.

MATERIALS AND METHODS

Survey. 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 to represent together the potato sector of the countries, on the basis of information collected during a rapid appraisal executed before the final design of the study. In both countries a stratified sampling frame was used with villages randomly selected within potato growing areas, and farmers were randomly selected in each village and interviewed by enumerators using 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 and agronomic practices of the farmers. The study also recorded farmers' perceptions on the importance of different attributes for variety adoption using a scale of 0 to 3. Descriptive statistics are used to describe farm households, agronomic practices and adoption levels of improved varieties and calculate mean score of each attribute for the varieties.

Study sites. Nyandarua and Meru central districts, which represent other districts in terms of varieties grown and management practices, were selected for the study. All the 8 main potato producing divisions and their 35 locations in the two districts were included in the survey. About half (43) of 88 sub-locations in these locations were randomly selected. One village was randomly sampled per sub-location and 6 farmers were randomly sampled from a list of all farmers obtained from village elders. Out of the 258 randomly selected farmers 251 were successfully interviewed.

In Uganda Kabale and Kisoro districts, the major potato producing districts were selected. 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.

RESULTS AND DISCUSSION

Characteristics of potato farms

The sample farms had an average family size of 6. 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. Kenyan farmers had higher Tropical livestock unit (TLU) compared to Ugandan farmers, indicating more manure could be available from their own herd.

Farmers in Kenya had larger areas under potatoes compared to those in Uganda. Most potatoes were grown as mono crops both in Kenya and Uganda and only few

such as yields, resistance to diseases, dormancy period or maturity period

[2] 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

plots[3] were intercropped with legumes, cereals or both. Only 18% of farmers in Kenya and 31% in Uganda reported having receiving agricultural advice within a period of one year.

Agronomic practices

Farming systems. In all four districts there is a bi-modal rainfall pattern allowing for two major potato growing seasons in a year. However, there is considerable off-season potato farming in Meru central, Kenya using irrigation and in Kabale in the swampy valley bottoms, using residual moisture combined with the odd shower.

Crop rotation is important to help maintain soil fertility and avoid the build-up of soil borne diseases and nematodes. However, the effectiveness of rotation regime is doubtful since most farmers do not remove the early sprouting volunteer plants which they value for home consumption. In Uganda, 58% of the farmers indicated they grow potatoes on the same plot only once in 4 seasons while in Kenya this was just 16%.

Reliable clean seed forms just a tiny proportion of less then 5% of whole seed market in the two countries with most farmers obtain seed from their own harvest or buy seeds of unclear quality from neighbouring farmers or the market. In Kenyan neighbours were the main sources of first seeds of varieties grown (84%) while only 6% of varieties grown originated from sources known to produce clean seeds, such as commercial seed growers or agricultural research stations (Fig. 1). In Uganda, the market was the major source of first seed for varieties grown while neighbours were the second most important source. Compared to Kenya, more farmers in Uganda reported receiving first seeds from sources known to produce clean seeds.

Yields were higher in Kenya than in Uganda mainly due to a high seed rate and higher input use. Yields for improved varieties were higher than for local varieties in both countries with improved varieties in Kenya yielding average of 9.7t/ha compared to local variety yields of 8.7 t/ha, while in Uganda improved varieties yielded 6.2t/ha compared to local variety yields of 3.4t/ha.

Late blight incidences and control. Late blight is a problem for most sample farmers as reported by 92% of Kenyan sample farmers and 86% of Uganda sample farmers. The disease was particularly important in Meru central where 98% of farmers said it posed a problem. Only in Kisoro district, Uganda a relatively high proportion of farmers (23%) said the disease was not important in production. Over 80% of 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.

Variety adoption and abandonment

The survey clearly indicated that the improved potato varieties released by national programmes have been widely adopted in both Kenya and Uganda, but more so in Uganda than in Kenya. In Kenya 43% of farmers had adopted improved varieties which occupied 36% of potato area while in Uganda 72% of farmers were growing improved varieties in 69% of the area under potatoes.

Diffusion of the varieties varies within the country. Farmers in Meru central almost exclusively grow red skinned potato varieties while in Nyandarua the three most frequently grown varieties (Nyayo, Tigoni, Tana Kimande) are white skinned (TABLE II). However, the predominant varieties in both districts have changed since 1976. Meru central district which has had a history of growing Kerr's Pink has largely abandoned it in favour of Ngure and Asante initially and recently also 'Tigoni red'.

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

In Nyandarua district the farmers growing Nyayo have increased from zero in 1976 to 92% in 1992 and then decreased to the current 54%. Roslin Tana reached 54 to 100% in different parts of Nyandarua district in 1988, but declined to only 1% in 2005. Farmers growing Tigoni have increased from the time of release in 1998 to reach the current 38%. This indicate a fast shifts in variety choice in Nyandarua possibly because traders come looking for cheap white skinned potatoes with good properties for production of French fries. Apparently traders in Nyandarua are not as specific about their variety choice as they are in Meru central.

In Kabale and Kisoro districts in Uganda Victoria (called Asante in Kenya) is the most predominant variety followed by Bumbamagara, Cruza and then Rutuku. In terms of production area Victoria was most important constituting 34% of total area under potato production. There has been a substantial diffusion of Victoria with the area under the variety estimated to be 3% in 1994 while in 2005 about 44% of farmers in the region were growing it at the expense of Rutuku.

Preferences for variety 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 IV). Each variety grown was scored on the ability to supply the attributes farmers perceived important and mean scores calculated for each variety (TABLE V& TABLE VI).

Market demand and skin colour.

Comparisons between predominant varieties in each region (

TABLE II &

TABLE III) and mean scores of variety attributes (TABLE V & TABLE VI) clearly indicate that during selection farmers are not only guided by the ability of the varieties to supply the attributes given prominence during farmer scoring but other factors come to play. During attribute rating marketability did not feature dominantly, but examining predominant varieties in each region indicate it plays a major role in variety choice by farmers. In Kenya none of the varieties scored more than 0.8 in marketability yet there is high demand of varieties such as Ngure and Kerr's Pink in Meru central. However, farmers scored Victoria and Rutuku very highly. This is probably because farmers were largely growing other less marketable varieties such as Cruza and Bumbamagara.

Skin colour 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 colour strongly affects variety choice. 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. The effect of market preference is also seen in Kabale and Kisoro districts where the white skinned Nakpot1 and Nakpot5 have had low acceptance despite their high yields.

Yield was a dominant trait used by sample farmers in variety scoring. Most improved varieties were considered to be high yielding but wide spread adoption could only be achieved if varieties first met the criteria of market demand. This explains why Ngure and Kerr's pink dominated in Meru central despite of their low yields.

Late blight resistance emerged an important variety attribute in both countries although it was also overshadowed by market demand. Farmers may not perceive late blight as a major threat because they can control it using fungicides. Neither are most farmers wary of health risk posed to them when applying 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). Adoption of late blight resistant varieties reduces the number of fungicide sprays required hence reduce health risk as well as the cost of production and the risk of yield loss.

In Uganda, adoption of Victoria leading to replacement of the more resistant Rutuku indicates that resistance alone is not the driving force in variety adoption. Victoria does however have a 'useful' level of resistance that allows for minimal spraying and results in limited risk of complete crop failure, and it is highly marketable in Uganda. In Meru central in Kenya, the same variety (called Asante in Kenya), as well as Tigoni red, which has a similar resistance level, are becoming more important at the expense of the very highly marketable Kerr's Pink and Ngure. As a result of the existing market preference however, this is a slow process. In Nyandarua, Kenya, the susceptible Nyayo is being replaced by the well marketable variety Tigoni, which has a similar useful resistance level as Victoria.

Taste is important for the potatoes grown for home use and was constantly used for scoring varieties. Kerr's Pink and Ngure were scored high for their taste and this could be the reason behind their high marketability. In Uganda farmers continue to grow Bumbamagara which was rated high in taste despite of its low yields and late blight susceptability.

Early maturity is important for food security and enabling households get income early to meet cash obligations such as school fees. It also allows farmers to squeeze a third crop during off-seasons period in high potential areas such as in valley bottoms of Uganda. 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. Earlyness may be one of the major factors contributing to the success of adoption of Victoria leading to farmer abandoning other varieties such as Cruza and Rutuku in Uganda.

Conclusions and Recommendations

Market demand emerged as the most important criterion underlying variety selection. Yield level was the second most important followed by late blight resistance, taste and then fit of the variety in their cropping system, especially earliness.

Late blight resistance is considered important by potato farmers, but is not the major factor determining variety choice. Results indicate that marketability is the major factor in variety choice. This means that market dynamics must be considered in variety development, release and especially promotion.

Potato farmers in Eastern Africa would be best served by national programs providing them with a choice of varieties with useful levels of late blight resistance that reduce the risk of high crop loss, and allow for minimal spraying strategies. Among the choices there should be varieties that answer farmers' specific marketing and cropping system requirements.

Rural markets played a much bigger role as a source of a new variety in Uganda when compared to Kenya. This could explain why there had been greater diffusion of improved varieties in Uganda than in Kenya where neighbours are dominant sources of a new variety. Past efforts in seed system development have concentrated on improved seed production by government parastatals and developing specialized seed multipliers. The source of seed and especially of new varieties is however non-specialized farmers. This needs to be considered when intervening in improved variety promotion and seed system improvement.

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TABLE I: Characteristics of surveyed potato farms in Kenya and Uganda, 2005

Characteristics	Kenya			Uganda		
	Meru central	Nyandarua	All	Kabale	Kisoro	All
Average family size	4.9 (2.3)	6.0 (2.5)	5.6 (2.5)	6.0 (2.3)	5.4 (2.2)	5.8 (2.3)
Average farm size (ha)	1.3 (1.2)	2.1 (2.0)	1.8 (1.8)	1.7 (1.6)	1.4 (1.0)	1.6 (1.4)
Tropical livestock Unit (TLU)[4]	2.6 (2.7)	3.3 (2.5)	3.0 (2.6)	1.1 (1.4)	0.5 (0.7)	0.9 (1.3)
Average area under potato (ha)	0.31 (0.30)	0.37 (0.32)	0.35 (0.31)	0.24 (0.26)	0.22 (0.19)	0.23 (0.24)
Sample size	**100**	**151**	**251**	**95**	**49**	**144**

Source; CIP survey 2005, Figures in parenthesis are standard deviation

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

TABLE II: Adoption levels of common potato varieties in farmer's in Kenya fields between 1976-2005 (%)

Common name	Other details	**Meru central**				**Nyandarua**		
		1976[a]	1988[b]	2001[c]	2005[d]	1976	1988	2005
White skinned								
Nyayo	Local	0	6	0	6	0	92	54
Tigoni	Improved	0	0	1	5	0	0	38
Tana Kimande	Local	0	0	0	0	0	0	25
Roselin Tana	Improved	2	6	0	0	0	54-100	1
Red skinned								
Ngure	Local	0	6	84	67	0	0	1
Tigoni red	Improved	0	0	0	30	0	0	1
Asante	Improved	0	0	20	22	0	0	2
Kerr's Pink	Local	100	92	51	20	59-81	0-15	9
Desiree	Improved	0	8	0	12	0-4	38-46	10
Komesha	Local	0	0	0	8	0	0	10

Source: [a] Durr & Lorenzi (1980), [b]Crissman et al. (1993), [c]Nyankanga et al (2004) and [d] CIP survey

(Meru central, n=100; Nyandarua, n=151)

TABLE III: Adoption levels of common potato varieties in farmer's fields in Uganda between 1994- 2005 (%)

Variety	Other details	Kabale & Kisoro		
		1994[a]*	1996[b]	2005 [c]
Red skinned				
Victoria	Improved	3	39	44
Kinigi	Improved	0	0	16
Rwangume	Unclear	0	0	13
Rutuku	Improved	30	57	10
Rwashakye	Improved	0	0	5
White skinned				
Bumbamagara	Local	0	6	19
Cruza	Improved	23	25	17
Kimuli	Local	0	0	3
Nakpot5	Improved	0	0	1
Marirahinda	Improved	10	0	1

* Percentage of total area given
[a]Rueda et al, (1996), [b]Low (2000), [c]CIP survey, n=251 (2005)

TABLE IV: Attributes considered when ranking good and bad qualities of varieties grown (%)

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

TABLE V: Farmer's quality rating of commonly grown varieties in Kenya, 2005[a]

Attribute	Meru central				Nyandarua					
	Asante	Ngure	Kerr's pink	Tigoni red	Tigoni	Nyayo	Tana Kimande	Komesha	Meru Mugaruro	Desiree
High yielding	1.6	1.0	1.1	2.1	2.1	1.0	1.0	1.9	0.5	0.5
Late blight resistance	1.1	0.2	0.2	1.4	0.7	0.2	0.6	0.1	0.1	0.1
Very tasty	0.6	1.0	1.2	0.5	0.3	1.1	0.3	0.4	0.2	1.2
Early maturing	0.1	1.4	1.3	0.3	0.3	0.8	0.3	0.4	0.3	0.3
Highly marketable	0.2	0.3	0.4	0.0	0.6	0.4	0.8	0.4	0.3	0.3
Tolerant to bacterial wilt	0.0	0.1	0.3	0.0	0.0	0.0	0.1	0.4	0.2	0.2
Big tubers	1.3	0.2	0.0	0.5	1.3	0.4	0.8	0.6	0.3	0.3
Drought tolerant	0.1	0.4	0.0	0.2	0.1	0.1	0.3	0.1	0.1	0.1
Sample size	**22**	**64**	**20**	**28**	**58**	**85**	**37**	**16**	**18**	**15**

[a] Average score on a scale of 0-3, where 0= not a factor, 1= a slight endowment, 2= high endowment, 3= Very high endowment
Source: CIP survey 2005

TABLE VI: Farmer's quality rating of commonly grown 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 endowment, 2= high endowment, 3= Very high endowment
Source: CIP survey 2005

Figures

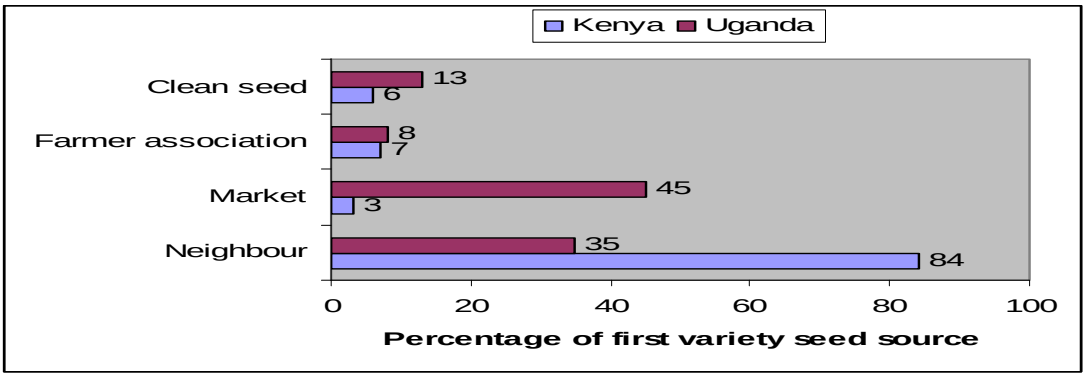

Figure 1: First sources of seeds for varieties growing (Kenya, n=442; Uganda, n=200)
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