



How Kenyan Potato Farmers Evaluate the Seed: Implications for the Promotion of Certified Seed Potato

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Abstract

Improving the quality of seed potatoes that smallholder farmers plant continues to represent one of the most important challenges of the potato sector in most developing countries to counter the long-lasting poor yields. This study aimed to better understand the way farmers choose seed potato by exploring the attributes they look for and the benefits they expect from them. We used means-end chains analysis in combination with Kelly's repertory grid as an elicitation technique and disaggregated data for male and female partners. In total, farmers named 38 attributes they look for when selecting seeds. Farmers associate "good" seeds to those that are well-sprouted, have many eyes, are of a variety they know, are medium in size, are certified, and are undamaged. Most preferred attributes lead to a higher yield and consequently higher income which is the most predominant avenue for farmers to achieve their desired values in life. Female farmers mentioned fewer attributes and also pursued fewer values than their male counterparts. Users and non-users of certified seed were shown to use the same attributes to select their potato seeds. Non-users of certified seed thus seem to be aware of the benefits of certified seed even though they are not using it. The results from this study indicate that increasing the availability of certified seed is not necessarily a straightforward way of improving the quality of seed potato planted by Kenyan smallholder farmers.

Keywords Attributes · Benefits · Certified seed · Gender · Life goals · Means-end chains

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Introduction

The Challenge of Increasing the Availability of Quality Seed Potato in Kenya

Although poor yield due to low use of quality seed potato has been reported by researchers for decades (Gildemacher et al. 2009; Kaguongo et al. 2014), improving the quality of seed potato that smallholder farmers plant continues to represent one of the most important challenges of the potato sector in most developing countries (Demo et al. 2015; Gildemacher et al. 2009; Hirpa et al. 2016). Increasing the availability of, and access to, quality seed potato sounds like a logical and straightforward pathway to improve production, available food, and income among smallholder farmers—as is advocated by many (Chindi et al. 2017; Devaux et al. 2021; Hirpa et al. 2016; Okello et al. 2017). This approach is in reality a difficult one to realise. The situation in Kenya is a case in point.

Research points out that returns on farmers' investment in quality seed would be high, suggesting that the limited availability of seed is the major limitation (Aheisibwe et al. 2016; Ayieko and Tschirley 2006; Wang'ombe and van Dijk 2013). Certified seed potato is produced in Kenya by over 30 registered seed merchants (NPCK 2022). These producers form a formal system with a defined certification process that guarantees quality. Unfortunately, this supplies less than 5% of the seed used by farmers (Kaguongo et al. 2014). The strict regulations and requirements for certification restrict the engagements of smallholder farmers and form a barrier to increase the production and thereby the availability and access to quality seed (McEwan et al. 2020). The cost of seed potato is among the biggest financial outlay for Kenyan smallholder farmers. Therefore, their willingness to pay a premium for quality seed is wholly contingent on that seed delivering a material benefit such as food security, yield, marketability, and economic return. The benefits of using quality seed have been highlighted in many studies (Kaguongo et al. 2014; Wang'ombe and van Dijk 2013) making it easier to assume that it would be a logical decision for Kenyan potato producers to invest in quality seed. However, this is not always the case as some seed producers have reported not being able to sell their seed (personal observations E.O. Atieno, first author). Furthermore, the informal system dominates the smallholders' seed supply in Kenya: farmers re-use their own saved seeds and acquire seeds from local markets and neighbours (Gildemacher et al. 2009; Kaguongo et al. 2014). Research shows that the quality of seed potato from this system is poor due to degeneration caused by an accumulation of seed-borne pests and diseases over time (Gildemacher et al. 2011; Janssens et al. 2013; Kaguongo et al. 2014; Thomas-Sharma et al. 2016; Were et al. 2013).

Various interventions have therefore supported alternatives to increase the availability of quality seed potato (Demo et al. 2015; Gildemacher et al. 2011; Komen et al. 2017; Schulte-Geldermann et al. 2014). This involves the so-called quality declared seed (QDS) whereby the seed is not formally certified, but quality assured through the reputational identity of the producer or producer group (see Hirpa et al. 2016; Louwaars and de Boef 2012; Schulz et al. 2013).

Production and supply of QDS follow a seed system based on the “decentralised seed multipliers” (DSM) model. Here, local producers are identified and trained to get certified seed from a formal source and multiply it further (Labarta 2015; Schulz et al. 2013). Given the bulkiness, perishability, and need for large quantities of seed potato to plant a unit area, the need for local availability to reduce the transportation cost becomes more important leading to popularity of this system. The seed is, however, not recognised by law in Kenya because it is not certified, hence is deemed illegal (Kaguongo et al. 2014; Muthoni et al. 2014). In Kenya, this decentralised seed production model has been introduced to the north rift region. The region is seen as the next frontier in Kenyan potato production, but no certified seed production is taking place in this region (Komen et al. 2017), which limits the access of potato producers to seed of guaranteed quality. All regions of the north rift except Turkana, i.e., Nandi, Uasin Gishu, Elgeyo Marakwet, Trans Nzoia, West Pokot, Baringo, and Samburu, produce potatoes, albeit at different scales (NPCK 2022). Potato production in the north rift region is mostly a household activity. It is increasingly becoming an important cash crop and source of income to many rural households. Its production has become a joint family venture with the involvement of both men and women who participate in different roles depending on their cultural and socioeconomic positions. Women are involved in most of the production activities in addition to their key role in ensuring the household’s food security (Mudege et al. 2020). Men tend to typically take key decisions related to marketing and purchase of production inputs even though implementation is carried out mostly by women and children. Cultural barriers have limited women’s access to important production resources such as land, inputs, and improved technologies (Mudege et al. 2020). There is, however, no systematic study of the gender roles and how disparities can affect decision-making and motivations in potato production activities.

Problem Description

We aim to contribute to the understanding of the use (or non-use) of certified seed by Kenyan potato farmers. While seed-system interventions in Kenya contribute to making quality seed potato available in the form of formally certified seed by centralised production, and QDS by decentralised producers, these are still based on the assumption that seed availability is the limiting factor. Following from this is the reasoning that increasing seed availability will increase the use of quality seed. With this study, we aim to better understand the way farmers choose seed potato by exploring the attributes they look for and the benefits they expect from them. We explore how the attributes and pursued benefits may vary for men and women and if farmers who use certified seed look for other attributes and benefits as those who do not use certified seed. The study used means-end chain analysis (Audenaert and Steenkamp 1997; Grunert and Grunert 1995) in combination with Kelly’s repertory grid as an elicitation technique (Paszowska-Rogacz and Kabzińska 2012; Kelly 1977). Thereby, samples of actual potato seed were presented to identify attributes farmers use to evaluate seed and why they value them. Means-end chain analysis

has been used by others to explore the mental models of potato farmers in Kenya (Okello et al. 2019). We focus on the attributes of seed tubers that farmers pay attention to in their choice of seed, and we reflect on the characteristics of certified seed with information available to its users on labels.

Materials and Methods

Description of the Study Area

The study was conducted in the north rift region of Kenya. The region is the country's breadbasket with maize as the leading crop. Five counties of Nandi, Uasin Gishu, Elgeyo Marakwet, Trans Nzoia, and West Pokot are among the 15 potato-producing counties in Kenya. Three counties of Elgeyo Marakwet, Uasin Gishu, and Nandi were selected for the study given their production scales in the region and the availability of interventions to improve farmers' access to quality seed.

Sampling Strategy

Farmers participating in the study were selected from the three counties. Purposeful sampling was used to target smallholder farmers in major potato-producing wards in the three counties. In Elgeyo Marakwet, two wards were selected, Kapyego and Metkei. In Uasin Gishu, Ainabkoi and Olare wards were selected while in Nandi, Nandi hills and Tinderet wards were selected. A list of potato farmers in each ward was obtained from the local extension office. The lists included farmers who had all participated in potato training activities organised within the ward by various stakeholders and therefore had some experience with potato production, which could also be assumed to know about potato diseases and the presumed value of certified seed and QDS. Seven or eight farmers were randomly selected from a list in each ward through the generation of random numbers using a research randomiser tool (www.randomizer.org) and assigning to participants. Fifteen farmers were identified in each county through the process and informed of their participation prior to the interviews. We managed to interview all selected 15 farmers in Elgeyo Marakwet while in Uasin Gishu and Nandi, we only managed to interview 12 each due to the unavailability of some during the interview day, resulting in a total of 39 farmers (22 were males and 17 were females). During the study, the selected respondents were called a day earlier and informed of the time for the interviews. On the interview day, the household heads were targeted. In total, our sample resulted to have 14 women-headed households. In three households, the male household head was absent, and we interviewed their spouses after confirming that they felt sufficiently familiar with the potato-growing practices of their households. Before each interview, the respondent signed an interview consent agreement stating their acceptance to participate in the interview process voluntarily.

Research Design

The study employed a means-end chain–sequential stage process that consists of three steps (Reynold and Gutman 1988). The first step involved elicitation of product attributes relevant to the farmer when selecting seed, followed by an in-depth interview process called laddering intended to reveal how the consumer links product attributes to consequences and values, and, finally, analysis of the data through the development of hierarchical value maps, depicting the aggregate farmers' means-end chains as expressed in the ladders.

Attribute Elicitation

We employed the triadic sorting technique based on Kelly's (1955) repertory grid sequential procedure to extract relevant product attributes. The stimuli for attributes elicitation in this study were three varieties of potato from three different sources. The varieties were Shangi, Sherekea, and Unica. Shangi is the most popular variety in the country. It gives oval-shaped tubers with whitish skin, matures early, is susceptible to late blight, and has a very short dormancy period. Sherekea gives round-shaped tubers with a reddish skin, matures late, is resistant to late blight, and has a very long dormancy period. Unica is a newly released variety with heat tolerance characteristics. Unica gives oval tubers with a reddish peel, matures early, is moderately resistant to late blight, and has a longer dormancy period compared to Shangi. Three sets of tuber samples of around 3 kg of each variety were packaged in a transparent bag (Fig. 1). Each bag was labelled to represent seed from three different sources namely certified seed source, decentralised seed multiplier, and local market. Each label included the name of the variety and the source. In addition, the bags with certified source also included the actual certification label (Fig. 1). These combinations resulted in a group of 9 objects (3 varieties \times 3 seed sources).

The three varieties and sources are well known to the farmers in the region. To identify their perceived differences among the seed lots, the researcher explained to the farmers that "It is planting season and you want to get seed potato for planting. I present you with three seed lots which you could use for planting. The seed lots are of different varieties and obtained from different seed sources". The samples were



Fig. 1 Potato seed lots with labels stating the variety and source. Seed lots obtained from certified sources contained the actual seed certificate (white circle)

then presented to the respondents in triplets. The respondents were asked to examine the three samples and put together two that were similar to each other but different to the third one. Respondents were then asked to verbalise the attributes that made the two similar but different to the third one. After the respondent exhausted the attributes for the distinction of the groups, the second set of three samples was presented by randomly removing one of the two that were similar and adding another sample chosen from the six that were remaining. The procedure was repeated with the condition that no object was included in more than two triads until all objects were presented or the interviewer felt that the respondent had exhausted the repertoire of constructs for the samples presented (Steenkamp and van Trijp 1997). The perceived distinct attributes verbalised by the respondent were recorded as opposing word pairs (e.g., damaged as opposed to undamaged). When all the word pairs were collected, the respondent was asked to specify which attribute in the opposing word pairs they preferred when selecting seed potato. This preference formed the basis for the laddering probing. For those farmers who did not understand English, this process was done in “Swahili.”

Laddering Interviews

The most preferred attributes/characteristics were used for laddering. The respondents were asked an iterative question “why is this important to you?”; in this way, the interviewer builds connections (ladders) between different attributes, consequences, and values that are personally relevant for the respondent. We used a soft laddering approach in which respondents were allowed to verbalise constructs themselves with very minimal restrictions (Audenaert and Steenkamp 1997; Grunert and Grunert 1995).

Analysis

The obtained ladders were first checked for completeness by classifying all responses into the three basic categories of attributes, consequences, and values. The literal responses were then coded into common denominators to allow for aggregation. Coding was done by two researchers independently and thereafter compared. In case of any differences, we looked back at the original transcripts to find the most suitable code.

The coded data was thereafter analysed using a Microsoft Excel-based–means-end chain analysis tool (Foolen-Torgerson and Kilwinger 2020). Via this tool, individual ladders were aggregated in an implication matrix using a number-of-respondents-based algorithm. This means a link between constructs is counted when made by a respondent, and if the same respondent makes the same link more than once, this is still counted as one (Kilwinger and van Dam 2021). A summary table in the form of an implication matrix was constructed representing the number of connections between the elements. The implication matrix reports the number of respondents making a particular connection between single categories of attributes, consequences, and values.

The summary of dominant connections was used to produce a hierarchical value maps (HVMs) indicating decision-making structures of different categories of farmers regarding the choices and use of seed potato. Links that were above a cut-off level of $n = 6$ were presented in the overall hierarchical value map. This means that all links presented in the HVM were made by six respondents or more. The number of respondents making a link was further illustrated by varying the thickness of the lines between constructs.

Results

Demographic Information

Table 1 summarises the characteristics of the 39 study respondents from the three counties in the north rift region of Kenya. Slightly more men than women were interviewed. The majority of the respondents (67%) had used certified seed, while 33% had never used certified seed. Certified seed users had on average a larger farm than the non-users of certified seed, and more of them regularly replaced their seed, irrespective of gender. While farming was the main income source for the majority of the respondents, more male users of certified seed and more women had income from other sources than the male non-users of certified seed. Payment of children's school fees took the highest percentage of the income of all farmers followed by

Table 1 Characteristics for male and female users and non-users of certified seed

	Male ($n = 22$)		Female ($n = 17$)	
	Users (18)	Non-users (4)	Users (8)	Non-users (9)
Age (SD ¹)	42 (12)	41 (5)	42 (9)	35 (5)
Years of experience potato production (SD)	11 (12)	14 (7)	5 (2)	11 (4)
Land ownership (ha)	3.9	1.9	5.1	1.4
Seed replacements				
% Replacing seed regularly	67%	50%	88%	33%
Main income sources				
Farming (%)	72%	100%	62%	78%
Others (%)	28%	0%	38%	22%
Main usage of income (% of the farmers mentioning the use)				
School fees	72%	75%	75%	67%
Basic needs	6%	0%	0%	11%
Farm inputs	6%	25%	13%	22%
Development	6%	0%	0%	0%
Investment	11%	0%	13%	0%
% Harvests kept for food	14%	12%	10%	13%

¹Standard deviation

the purchase of farm inputs, investment, basic needs, and development, respectively (Table 1). Farmers also kept less than 15% of their harvest for food.

Attributes Mentioned by Farmers in Seed Potato Selection

In total, farmers named 38-word pairs during the elicitation task when they were asked to evaluate the seed lots based on (dis)similarities. Table 2 shows the top 17 preferred attributes mentioned more than four times by respondents. Farmers mentioned 3 to 12 attributes with an average of 6 per farmer. There was no difference in the average number of attributes that male and female farmers mentioned or certified seed users and non-users of certified seed during the attribute elicitation task.

Table 2 Content of attributes generated during the elicitation process, relation to seed quality components and farmer preferences

Attributes ¹	Male (22)		Female (17)		Total
	Users (18)	Non-users (4)	Users (9)	Non-users (8)	
Tuber size					
Medium	18	3	9	7	35
Uniform size	5	0	2	0	7
Eyes					
Many eyes	14	2	6	6	28
Clean eyes	2	0	1	2	5
Sprouting					
Sprouted	7	4	5	8	24
Physical (skin) appearance					
Undamaged	6	1	4	7	18
Disease free	7	2	5	4	18
Clean	5	2	0	0	7
Certification					
Certified	8	2	1	3	14
Variety					
Known variety	6	1	3	3	13
Oval	4	1	2	1	8
Round	4	1	0	0	5
Red	4	0	2	0	6
White	3	1	0	0	4
Early maturity	4	0	1	1	6
Marketable	3	0	2	1	6
Seed source					
Known source	3	0	1	3	7

¹Only 17 out of 38 attributes which were mentioned more than four times are shown in the table. These also represent the most preferred attributes in the word-pairs mentioned in each category by farmers during the attribute elicitation process

When we clustered the attributes in seven groups (Table 2), it was observed that the certified status of the seed lot was only mentioned by 14 farmers (36%). It was mentioned as a (positive) attribute with about the same frequency by certified seed users as by non-users of certified seed. Men mentioned the attribute more often than women. The most frequently mentioned attributes were related to the variety (24%), physical skin condition of the seed tubers (23%), and tuber size (16%). The variety being known was important, as well as variety-related tuber characteristics: some preferred oval over round shape or white over red and vice versa. This is explained by the observation of the first author on the somewhat different variety dominance in the three sampled counties, while in Nandi, the variety Sherekea (round tuber, red skin) is popular (because of its somewhat better storability as ware potato and high yielding characteristics), in the slightly cooler Uasin Gishu and Elgeyo Marakwet variety Shangi (oval, whitish skin) is liked by farmers for its high yields and short dormancy period (for replanting). All farmers consider it important to have medium-sized seed tubers while some also valued the uniformity of seed tuber size. The seed tubers having many eyes and being sprouted (broken dormancy) were also frequently mentioned, more often than being certified. The differences in terms of attributes mentioned and the frequency with which they were mentioned did not show consistent differences between users and non-users of certified seed or between gender.

Farmer's Evaluation of Attributes for Their Seed Potato

Of the 38 attributes that farmers mentioned, 10 appeared in the hierarchical value map using a cut-off level of 6. Some chains in the HVMs start or end at the consequence level. This can occur if the relations made between attributes and values are highly variable among respondents and hence do not reach above the cut-off level. In general, the HVM in Fig. 2 shows that when farmers used “good” as an attribute of seeds, they associated this seed with seed tubers that were well sprouted, of a variety they knew, had many eyes, were medium in size, and were certified and undamaged. They believed these characteristics would lead to high yield and income that would help them achieve their desire for self-development, better health, good life, peace of mind, happiness, and the ability to support their households. These were their most important values.

Sprouted tubers were preferred as seeds because they emerge uniformly and fast. Farmers considered that, therefore, the potatoes would mature early, providing them a better price in the market when they could sell early in the season. When potatoes could be easily marketed, farmers would save time which they could then use for other activities. Known varieties were preferred because farmers knew whether they were marketable in the area, and how they would perform in the field was also known. When the performance was known, the farmers could make better plans (e.g., when to plant, when to apply fertiliser or pesticides, when to harvest) and could achieve higher yields. Tubers with many eyes were preferred because they would have a higher survival rate and would produce more stems ensuring efficient use of resources, eventually leading to higher yields. The preferred tuber size was medium, mainly because farmers could plant a larger area with one bag of seed. This means

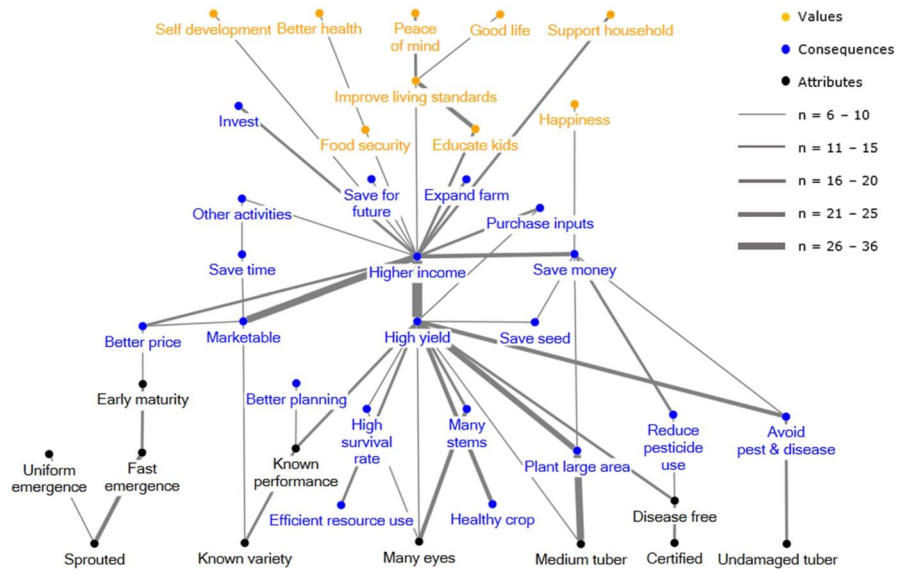


Fig. 2 Hierarchical value map of all farmers ($n = 39$). Black nodes represent concrete and abstract attributes, blue nodes represent functional and psychosocial consequences, and orange nodes represent instrumental end-terminal values. Cut-off level $n = 6$

they could save money on investments in seed. Farmers said they preferred certified seed because it is free of diseases and hence requires a lower use of pesticides which saves money. For the same reason, tubers without damages were preferred, using undamaged tubers avoids pests and diseases in the crop which would increase yield and would allow money to be saved.

Most preferred attributes lead to a higher yield and high income. All values eventually are related to a higher income, making it the most predominant avenue for farmers to achieve their desired values in life. Higher income occupied a central position when farmers were choosing the seed potato to plant. Therefore, they chose attributes which produce suitable consequences, such as high yield, marketable tubers, and a better price, that lead to higher income to satisfy their personal values and goals.

Gender Differences on the Evaluation of Potato Seed

Separation of the farmers based on gender showed a slight deviation from the aggregated HVM. In Fig. 3, using a cut-off level of 4, female farmers preferred fewer attributes compared to male farmers. Female farmers also pursued fewer values than their male counterparts. For female farmers having a known variety was important because it would be marketable and would result in higher income as an avenue for having peace of mind. Female farmers preferred disease-free seed which saved them money from reduced pesticide usage to buy food, hence ensuring food security for

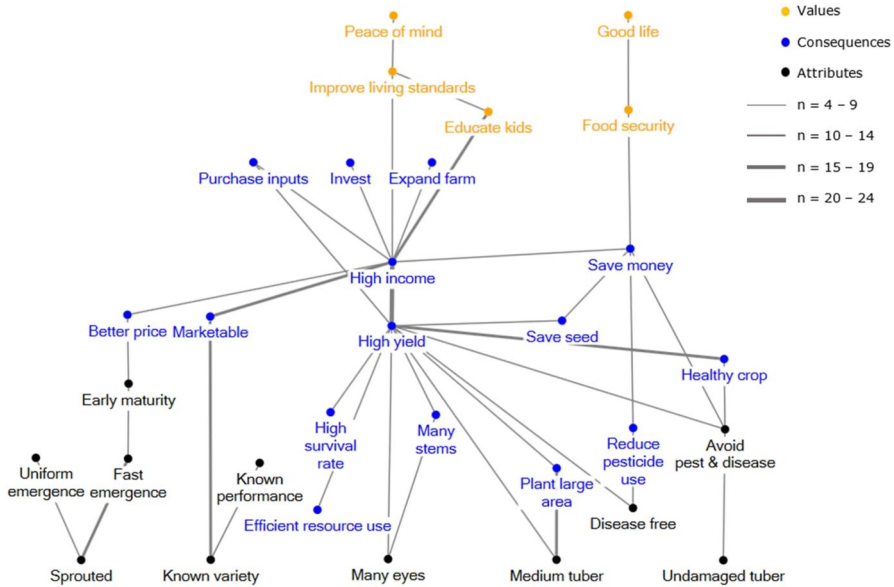


Fig. 3 Hierarchical value map of female farmers ($n = 17$). Black nodes represent concrete and abstract attributes, blue nodes represent functional and psychosocial consequences, and orange nodes represent instrumental end-terminal values. Cut-off level $n = 4$

their families and a good life. Instead of relating food security to a high income, females more often related food security to saving money. Furthermore, on the HVM of female farmers, saving seed was related to saving money. This pathway is not present in the HVM of male farmers. Certified seed did not appear in the HVM map when using a cut-off level of $n = 4$, indicating that for female farmers, this was not a very relevant attribute.

Male farmers looked for more attributes than female farmers. Medium-sized and sprouted tubers were the most relevant attributes in defining seed choice. In addition to the attributes that women looked for, male farmers considered certified seed as contributing to lower pesticide use and thus saving money. They perceived the oval shape of tuber related to marketability as an additional attribute leading to higher income (Fig. 4). The male farmers also pursued more values compared to their female counterparts. Community development, good life, peace of mind, and supporting the household were the most important values pursued by male farmers. Interestingly, higher income was the most important consequence of the preferred attributes towards pursuing the values. This was to the extent that time saved as a consequence of having oval shape seed which was marketable was used for other activities aimed at still increasing the income (not visible as consequence of $n = 4$ as cut-off level).

Both men and women focused on saving money while selecting their potato seeds. For both men and women, there were two major pathways that allow them to save money. The first was via the tuber size. Both men and women preferred a medium tuber size because a larger area could be planted. Men directly linked this to

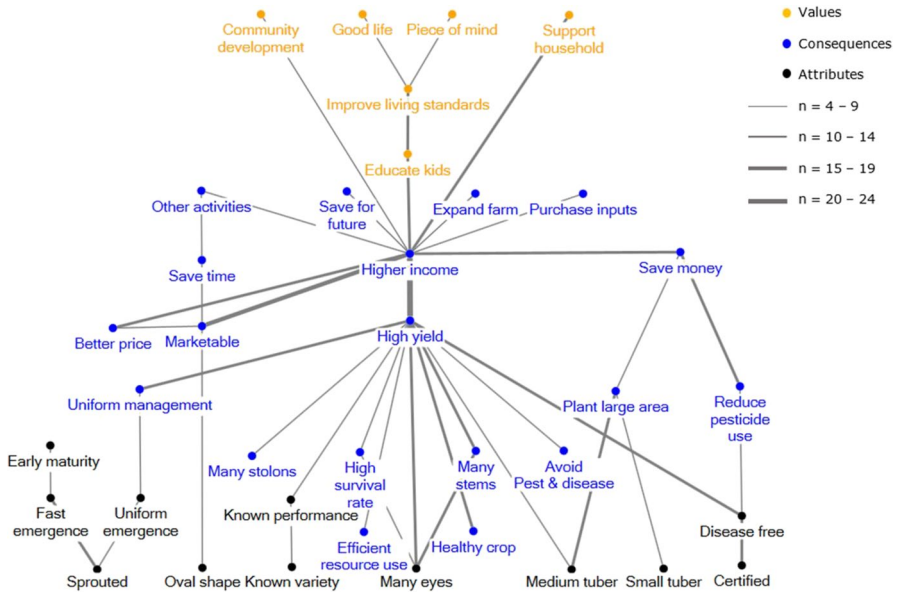


Fig. 4 Hierarchical value map of male farmers ($n = 22$). Black nodes represent concrete and abstract attributes, blue nodes represent functional and psychosocial consequences, and orange nodes represent instrumental end-terminal values. Cut-off level $n = 4$

saving money whereas women made the intermediate links that this would lead to a higher yield from which seed could be saved. The other pathway to save money was via a reduction in pesticide use. Both men and women related this to disease-free material. However, men found disease-free material by looking for certified potato seed to be disease free whereas women looked at tubers without damages to avoid pests and diseases in the crop.

Men did not link saving money to any higher-level values. For men, saving money meant that more income would be available, and a higher income was related to personal values such as educating their kids and supporting the household. Women on the other hand related saving money to food security. Women appeared to put more emphasis on choosing known varieties because those varieties would be marketable.

Differences in Potato Seed Evaluation Between Users and Non-Users of Certified Seed

HVMs for users of certified seed were largely following the same attributes as those of non-users of certified seed. However, farmers who used certified seed were shown to pursue more values than their counterparts who did not use certified seed. Also, these farmers mentioned more attributes on good seed than non-users of certified seed; of interest was the preference of both medium and small tubers (Fig. 5). High yield and high income were the most important consequences. Support to household, self-development, peace of mind, and food security leading to better health

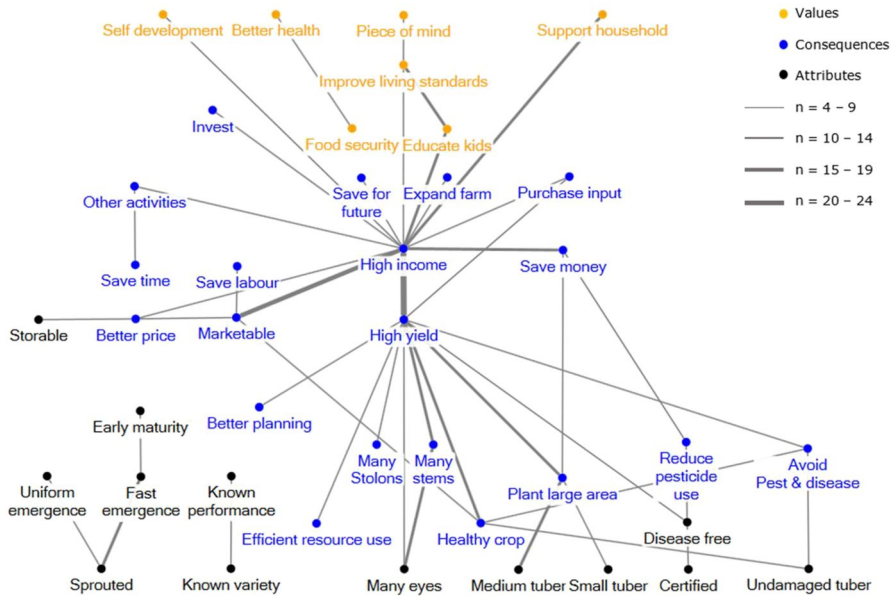


Fig. 5 Hierarchical value map of certified seed users ($n = 23$). Black nodes represent concrete and abstract attributes, blue nodes represent functional and psychosocial consequences, and orange nodes represent instrumental end-terminal values. Cut-off level $n = 4$

were the main values pursued by users of certified seed. Most attributes preferred were associated with high yield, the seed being sprouted and knowing the variety. Higher income was shown to enable certified seed users to invest, save for the future, expand their farms, educate their kids, and purchase more inputs in the quest of pursuing their desired goals in life.

HVM for non-users of certified seed showed that these farmers pursued very few values (Fig. 6). Most preferred attributes were related to high yield except for sprouted and known variety which were related to high income. Non-users of certified seed only pursued having peace of mind emanating from educating their kids to improve their living standards from the high income. Non-users of certified seed also preferred certified seed (which they related to disease-free seed) as an attribute even though they had never used. The consequence for using certified seed for them included saving seed for the coming season.

Discussion

Attributes Used by Farmers to Evaluate Potato Seed Tubers

The top four mentioned attributes from which farmers expected benefits were (medium) tuber size, known (marketable) variety, (many) eyes, and sprouts. High yield and marketability were, overall, the most important benefits: this confirms

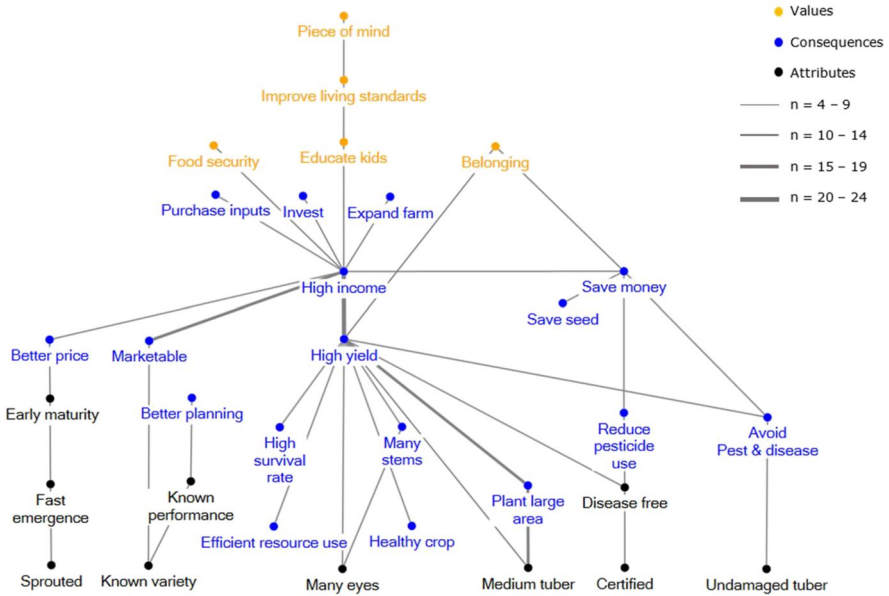


Fig. 6 Hierarchical value map of farmers who have not used certified seed ($n = 16$). Black nodes represent concrete and abstract attributes, blue nodes represent functional and psychosocial consequences, and orange nodes represent instrumental end-terminal values. Cut-off level $n = 4$

the cash-crop nature of potato in this region. Women farmers tended to consider household food security and saving money as considerations in their preferred source of seed, while men predominantly focused on marketability, high yields as benefits from good seed to arrive at higher income. The attributes that women farmers sought in potato seed, the benefits they expected from them, and to what personal goals these contributed were slightly less diverse than those of male farmers. The absence of clear difference related to gender is not surprising given the almost exclusive cash crop character of potato in the area and the joint participation of man and wife in the production of the crop. An interesting observation is that both men and women find disease-free potato seed important, but men seem to use seed certification as an indicator whereas women make a physical observation of the seed: they especially look for damages on the tuber that can get easily infected. This can be explained by the perception of men being the household heads; they more often participate in extension services and are selected for trainings giving them an upper hand on access to information (Mudege et al. 2017).

We observed a difference between men and women regarding the importance of the attribute “certified seed,” but not among users and non-users. This suggests that non-users were aware of the benefits of certified seed. Also, non-users of certified seed said it was important to them to be able to save seed whereas this was not mentioned by users. The price of seed was not mentioned as an attribute of any source of seed. From this, we conclude that the means-end chain analysis did not provide a clear explanation for the reason why some farmers used certified potato seed and

why others did not. However, given the very contrasting differences in farm size of users vs non-users of certified seed (Table 1), it is very likely that the costs of seed play an important role in the decisions of these smallholder potato farmers. Smallholder farmers have many other objectives that are non-farming related based on which they might prefer to spend their available cash (Mausch et al. 2021; Verkaart et al. 2018). Being cash-constrained is a general phenomenon in West Kenya and even more so for the poorest households (Almekinders et al. 2021). Using farm-saved seed that yields sufficiently might therefore be preferred over seed that requires cash but might provide a higher yield. The further attributes that non-users of certified seed were looking for and the expected benefits were very similar to those who had used certified seed one or more times; there were no indications that their smaller farm or less knowledge played any role in their preferences for planting material.

The Importance of Certified Seed

As compared to the marketability of the variety, tuber size, and sprouts, certification and disease-free seed were important attributes for the farmers in this study. Those who mentioned certified seed associated it with disease free. As mentioned, the price of seed did not show up as a (negative) attribute or consideration that male or female farmers of (non)-user of certified seed had in mind, although certified seed is known to be costly (Kaguongo et al. 2014).

Once we indicated to them that some of the seed lots were certified, many farmers mentioned they preferred certified seed. However, we observed that the majority of these farmers did not look at the actual label provided in the bags (see Fig. 1) to confirm our claim. This might suggest that farmers do not use the actual certificate as an indicator for certified seed but may use other cues, like, e.g., their trust in the provider of the seed. Seed certification is based on labelling. Labelling is a concept very common in Western societies where nearly all commercial goods are provided with one. Labels on goods contain a range of information such as ingredients, instructions, quality marks, and safety icons. Behind these labels is a whole world of institutions, standards, regulations, licences, and inspections. Over the years this has provided the consumer or user with trust in the label. Most of the information a consumer or user desires to know about a good can be found on its label, and consumers/users make use of it on a daily basis. However, in the context of smallholder farming, this might not apply. There are reported instances where farmers do not read or understand the safety information displayed on pesticide product labels (Waichman et al. 2007). Almekinders et al. (2021) also reported the lacking attention of farmers for the information on bags and labels of maize seed in western Kenya. Because in rural Africa, labels do not exist for the majority of the products available, consumers/users find their quality cues in a different way. When a farmer wants to get information on the quality of planting material, there are numerous options in case, they, for example, source from a neighbour; they can continuously observe the neighbour's field; they can inspect if there are diseases; they know the neighbour's management; they have experience with trusting the neighbour; and they can

visually observe the planting material. Seed certification is based on another principle. The seed is often produced at specialised places that are inaccessible for farmers. Instead, the quality cues are inscribed on the label, and this label must provide the trust that what is written on it is true. The quality cues invisible for the farmer to observe with his/her own eyes are made visible on paper. This implies that farmers must learn to read, understand, trust, and value the label (Bartle and Maredia 2019). It should be taken into consideration that this transformation from using observable quality cues to written quality cues does not happen overnight. This is in line with the findings of a comparable study conducted among potato farmers in the Peruvian Andes that concluded that labels do not override the quality cues that farmers have learnt to use and rely on over generations (Urrea-Hernandez et al. 2016). And, moreover, which may in many instances have proven to be more reliable than the information provided by researchers and labels on the bags or packages in which the seed is sold.

Conclusions

The results from this study indicate that increasing the availability of certified seed is not necessarily a straightforward way of improving the quality of potato seed planted by Kenyan smallholder farmers. It may well be that farmers, both users and non-users of certified seed, are not sufficiently aware of the benefits of using this seed. Or, in the case of users of this high-quality seed, they may not have been convinced by their experiences with the benefits. Since certified seed and disease-free were two closely associated attributes and distinct from physiological characteristics like sprouting and various features, it may also show that disease pressure in this part of Kenya is not as important as issues that farmers may have with sprouting, readiness to plant, and marketability. Simply striving to increase the availability of seed without understanding the broader context and considerations of farmers in their decisions on the use of potato seed seems a risky pathway to improve potato production.

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Declarations

Conflict of Interest Paul C. Struik is the editor-in-chief of Potato Research.

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