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Why Gender Matters in Breeding: Lessons from Cooking Bananas in Uganda

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Abstract: This study examined the gender-differentiated trait preferences of cooking banana (*matooke*) for farmers and consumers in Central Uganda to inform banana-breeding strategies. Women and men banana farmers might have differing production objectives, norms, and values which drive decisions on which varieties to adopt and grow. However, breeders rarely consider this in their variety development programs, leading to lost opportunities for equitable breeding. An exploratory sequential mixed-method approach was used to obtain a richer understanding of the trait preferences of women and men, which explains the acceptability of cooking bananas. Consumer preference tests for the candidate banana varieties and released hybrids were also conducted. The results showed that the universal attributes for variety selection were bunch size, taste, resistance to pests and diseases, drought tolerance, food texture/softness, maturity period, and finger size. Men appreciated agronomic and market-related traits, such as tolerance to drought and poor soils, bunch size and compactness, maturity period, and shelf life, while women valued processing and cooking traits such as flavour, food colour, ease of peeling, finger size, and agronomic traits such as plant height. These are plausible attributes for the gender-responsive breeding of bananas. The findings highlight the need to redesign the banana-breeding pipeline and process in Uganda to deliver varieties with attributes desired by women and men along this commodity value chain. A participatory demand-driven and gender-responsive process involving stepwise selection criteria that commences with quality traits followed by production traits while integrating gender-specific preferences should be employed to ensure the acceptability of cooking banana hybrids by women and men end users. This requires integrating different disciplines, including social scientists and gender experts, along the entire breeding process for more inclusive products and equitable outcomes.

Keywords: cooking bananas (*matooke*); Central Uganda; trait preferences; gender; breeding



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1. Introduction

Gender-differentiated trait preferences are rarely considered in crop-variety development programs. Even when considered, there is a paucity of evidence on the level of

contribution to social or economic outcomes. Furthermore, the impact of a more gender-responsive approach on immediate breeding outcomes, including adoption and commercialisation, is rare in the literature. Studies have shown that women and men adopt new technologies, including new crop varieties, at varying rates, mostly due to gendered differences in access to knowledge, access to, and control over productive resources and benefits. Women tend to adopt improved technologies at a lower rate than men farmers, mainly because such technologies do not consider women's needs, preferences, and resources [1,2]. Women and men often have diverse preferences for varietal characteristics driven by their gendered roles and responsibilities that govern the selection and production of crop varieties associated with certain traits [2–7]. Women farmers often prioritise other needs in their roles as mothers, caregivers, and custodians of households [5]. Differences in preferences can occur due to contrasting roles and responsibilities of women and men, or if women and men grow the same crop under different conditions [8]. Breeding programs often fail to consider the gendered preferences of farmers because they (breeders) may not be aware of them [9,10]. This may result in a mismatch between breeding priorities and end users' preferred traits which could potentially translate into the low adoption of improved varieties of important crops.

The East African highland cooking bananas (*Musa* spp.), also known as *matooke*, are an important staple food and cash crop that supports over 17 million Ugandans. The crop is valued for its socio-economic importance, especially in Central and Western Uganda. However, *matooke* productivity has declined because of various biotic and abiotic factors, such as pest and disease infestation, which reduce yield and quality. Over time, breeding new crop varieties has been identified as one of the most feasible strategies for addressing ecological and environmental-related constraints. Therefore, the Uganda national banana program constituted a breeding program to produce high-yielding disease- and pest-resistant cultivars for food and income security. To date, the program has introduced and released several varieties which have been received with mixed success. In the past, breeding programs assumed that improved cultivars were always better than existing local land-race cultivars and should therefore be adopted [11]. However, empirical evidence shows that most farmers continue to grow local cultivars alongside improved ones, and in some instances, grow only their local cultivars due to tradeoffs in characteristics. Banana farmers prefer local cultivars because they have superior consumption characteristics and multiple cultural uses, even though they are more susceptible to pests and diseases than hybrid cultivars [12–16].

Farmers also consider a diverse array of traits before making production decisions, and improved varieties may not address all of their needs [17,18]. As such, banana farmers tend to adopt new cultivars which combine improved production and desirable consumption characteristics [19,20]. Other studies [21] further report that farmers consider a wide range of criteria to evaluate varieties such as agronomic characteristics that include yield and pest resistance, and consumption characteristics such as cooking and taste qualities. It is possible that improved banana hybrids could have attributes that fail to meet the needs and preferences of end users, leading to low uptake and adoption. From a gender perspective, women and men *matooke* farmers might have differing production objectives, norms, and values which drive decisions on which varieties to adopt and grow. For example, Mulugo et al. [22] noted that specific banana cultivars are used in different cultural practices related to childbirth ceremonies, marriage ceremonies, funerals, and funeral rites. Thus, the various societal beliefs associated with banana varieties guide farmers' choices, uses, and cultural connections with the varieties that farmers grow. The same study alludes to the fact that while men prefer growing high-yielding cultivars with big fingers and bunches for the market, women prefer cultivars that yield multiple (small to medium-sized) bunches continuously throughout the year. Such varieties are perceived to have a good taste, associated with flavour, colour, texture, and aroma [ibid]. Women also prefer traditional cultivars with soft leaves, which are important for steaming food and preparing traditional dishes locally known as *mpombo*.

Addressing the needs and trait preferences of end users requires a clear understanding of the key drivers of selecting new banana cultivars by women, men, and other social categories along the banana value chain. However, the consideration of such gendered aspects in the national banana-breeding program was not prioritised by the time this research was conducted. The lack of consideration of gender-specific needs and traits in most breeding pipelines may potentially lead to lost opportunities for gender-equitable breeding outcomes [23]. Polar et al. [24] (citing [25–28]) argue that the lower adoption of modern varieties among women producers emerges as a significant trend in the broad context of technology and innovation in agriculture, reflecting unequal access to technology. This unequal access may imply that technology is physically not equally accessible, or that the technology developed has not considered or does not respond (equally) to the needs and demands of gender-differentiated end-user segments. A clear understanding of gender-differentiated trait preferences of end users along the value chain is therefore needed to effectively guide demand-driven and gender-responsive breeding programs and consequently facilitate the adoption of new crop varieties. A short historical overview indicates a paucity of literature on gender-differentiated banana traits. A recent review conducted by Marimo et al. [12] indicated that from a total of 44 studies that documented banana trait preferences in general, only 4 reported gender-differentiated preferences. At the time of publication, only one study [17] specifically focused on gender-differentiated preferences. Since then, a few other studies have been conducted which use gendered analysis to highlight banana preferences (see [29–32]). Although documentation of gender-differentiated banana trait preferences along the banana value chain has been steadily increasing, more context-specific research in different parts of Uganda needs to be conducted to build that body of knowledge.

The Gender-responsive Researchers Equipped for Agricultural Transformation (GREAT) project funded by the Bill and Melinda Gates Foundation is one such initiative that has over time supported the generation of case studies that demonstrate why breeding efforts need to be gender responsive. This article presents findings from a case study which focuses on identifying and prioritising the gender-differentiated trait preferences of *matooke* farmers and consumers in Central Uganda. The overall objective was to explore how the trait preferences of women and men shape the acceptability of cooking banana cultivars, to inform current and future breeding efforts. Specifically, the study aims are the following:

- (1) Identify the cooking banana varieties preferred by women and men banana farmers and consumers and the desired traits associated with such varieties.
- (2) Analyse traits that influence the acceptability of cooking banana varieties by women and men banana farmers and consumers.
- (3) Evaluate the selected promising banana genotypes for acceptability by women and men consumers.

From these objectives, the overarching research question that guided the research was as follows: How do the needs and preferences of women and men shape the acceptability of cooking banana varieties? The specific research questions for this study were as follows: Are there gender differences in variety and trait preferences for cooking bananas in Central Uganda, and are these statistically significant? How do the results differ if a gender-blind (“status quo”) and gender-differentiated approach are used in the data analyses? How does gender-differentiated information inform banana-breeding processes? The current breeding program often involves women and men end users at the end of the breeding cycle, usually when selecting varieties that will be officially released [12]. The data gathered and analysed are often gender blind and do not differentiate the needs and preferences of women and men and other social categories in the value chain. This case study generates evidence that is sex-disaggregated to better inform the banana-breeding process by comparing results from an analysis of a typical gender-blind versus sex-differentiated approach.

2. Materials and Methods

2.1. Study Area

The study was conducted in the central region of Uganda which was once the main banana-producing areas in the country until the 1990s, when pests, diseases, and labour constraints became major limiting factors to banana production. Mulugo et al. [22] described nearly all banana cultivars (including cooking bananas, commonly known as *matooke*) grown in Central Uganda and their uses. In response to the problem of banana pests and diseases, new and improved banana varieties (*matooke* hybrids denoted with the “M” symbol, that is, M9, M19, and M27, among others to mean *matooke*) have been developed and introduced to revamp production levels, although their adoption rates have been reported to be low in this region [33]. Two districts, Mukono and Wakiso, were purposively selected for this study based on their participation in banana research and development (R&D activities conducted by the National Banana Research Program (NBRP) of NARO). Evaluation trials and sensory evaluation exercises for *matooke* hybrids are usually conducted by farmer research groups in the selected districts.

2.2. Research Design

The study followed a mixed-methods research (MMR) approach, particularly the exploratory sequential mixed-methods research design employing both quantitative and qualitative data collection methods [34]. Qualitative data were collected and analysed in the first phase, which informed the collection and analysis of quantitative data in the second phase. The MMR design was important for obtaining a comprehensive and richer understanding of the needs and preferences of women and men.

2.3. Study Population, Sampling Procedure and Sample Size

Both purposive and random sampling procedures were used to select the study sites and respondents involved in the study. Mukono and Wakiso districts in the central region were purposively selected due to prior participation in research activities, but also because of easy access given the resource limitations. In each district, only sub-counties that had previously participated in NBRP breeding activities were purposively selected, that is, Gombe and Kimmenyedde in Wakiso and Mukono districts, respectively. Sensory evaluations were conducted in the two selected sub-counties, while the rest of the research activities were implemented only in the Kimmenyedde sub-county, Mukono district.

Phase one focused on qualitative data collection with the aim of exploring the preferred traits of men and women that determine their choice of cooking bananas. Four sex-disaggregated (composed of women only and men only) group interviews were held with banana farmers (two for women, two for men) and four sex-disaggregated focus group discussions (FGDs) (two with women, two with men) were held with banana consumers. Additional key informant interviews (KIIs) were held with other value chain actors to obtain qualifying information. Seven KIIs with selected banana actors including banana farmers, consumers, farmer leaders, extension agents, and traders were conducted for this purpose. The number of qualitative surveys was estimated based on guidance from Namey et al. [35], a meta-analysis which showed that by the 6th KII, most qualitative surveys would have unearthed up to 60% of the themes, 92% by the 12th KII, and saturation by the 17th respondent. Conversely, most surveys unearth 92% of all possible themes and attain saturation by the 3rd FGD [36]. For the group interviews and FGDs, farmers and consumers, respectively, were selected based on their knowledge of banana varieties, production, and consumption. Deliberate efforts were made to include different gender categories. Key informants were purposively selected based on their role in the banana value chain, with a focus on production and marketing. A total of 49 respondents participated in the sex-disaggregated group interviews, 58 in the FGDs, and 7 in the KIIs.

Sensory evaluations of the candidate banana varieties and released *matooke* hybrids were also conducted—three hybrid varieties (M27, M19, and M9) against a preferred local cultivar (*Nakitembe*). A total of 58 panellists, including adult women and men and youth

(male and female), participated in the sensory evaluation sessions. Data were collected on the age, sex, and level of education of the panellists.

For the intra-household survey, a sampling frame was developed from which 100 banana farm households in the selected sub-county were randomly sampled, and both primary males and females were interviewed in 87 households, representing a response rate of 87%. In total, 174 respondents were interviewed. This sequential mixed-methods approach aimed at providing a richer understanding of the trait preferences of women and men that explain the acceptability of the *matooke*.

2.4. Data Collection Methods

In phase one, we explored the preferred traits of men and women to determine the acceptable cooking bananas. Several methods were used, including sex-disaggregated group interviews, focus group discussions, and key informant interviews. During the group interviews, the pairwise ranking method was used to identify and prioritise the most important attributes of women and men when choosing a cooking banana variety to grow.

In the sensory evaluation, panellists scored the sensory quality attributes (taste, colour, flavour, and texture) and general acceptability of the samples using a *hedonic* scale of 1–6, where 6 = like extremely, 5 = like very much, 4 = like, 3 = like fairly, 2 = dislike, and 1 = dislike very much. At the end of the individual scoring exercise, a focus group discussion was held with sensory evaluation panellists to discuss the *matooke* parameters evaluated in depth and obtain qualitative descriptions of what matters most and why.

In phase two, a cross-sectional intra-household survey was conducted. In each household, both primary adult male and female were interviewed face-to-face using a semi-structured questionnaire. Prior to data collection, a pilot study was conducted to pretest the questionnaire for reliability and suitability which was preceded by intensive training for research assistants engaged in data collection. Data were collected on banana production objectives, varieties grown (both local and hybrids), preferred traits, reasons that explain banana varietal preferences, and information required to enhance acceptability and uptake of new banana varieties. In addition, data were collected on the demographic characteristics of the farmers (age and formal education) and other household variables, such as household size, household type, main occupation, land access, and utilisation. During the face-to-face interviews, each respondent was asked to list the five most important varieties of cooking bananas, which were then ranked on a scale of 1–5, with 1 being the most important. To identify gender-differentiated banana varietal preferences, each respondent was asked to list the most important preferred attributes which form the basis for selecting the banana varieties they grow. The selected attributes were then scored on a scale of 1–10 (1 = most important; 10 = least important). Respondents were then asked about the variety associated with each selected attribute. The questionnaire was designed using the Census and Survey Processing (CSPro 6.3) application for online data collection using tablets.

2.5. Data Processing and Analysis

The qualitative data collected from the local dialect (Luganda) were translated into English and transcribed verbatim for analysis. Thematic analysis employing an inductive approach was used to analyse the data. Open codes were assigned to individual narratives until saturation was reached. The codes were then grouped into categories and themes. The quantitative data entered in CSPro 6.3 was analysed using Microsoft Excel and Stata 15.1 to generate descriptive (frequencies, means, standard deviation, and percentages) and inferential statistics. Two analytical scenarios were used to analyse the data on preferences: (a) Scenario I: represents the “gender-blind” scenario where data were analysed and presented in a non-sex disaggregated manner. This represents the scenario often used by the banana-breeding program where women and men are involved in the participatory variety selection process towards the end of the breeding process; however, their views are lumped together with no conscious effort to differentiate their needs and preferences. (b) Scenario II: is the “gender-differentiated” scenario in which the data for women and men were

analysed separately. Sex disaggregated analysis is useful for assessing the similarities and differences in the preferences of women and men. Disaggregated data can better inform breeding programs. A *t*-test and level of significance set at $p < 0.05$ was used to examine the association between gender and trait preferences. The obtained results are presented in the form of graphs, tables, and charts.

3. Results and Discussion

3.1. Sample Characteristics

The survey results indicated that most of the farmers (81.1%) were from dual households with both male and female spouses (Table 1). Only 11.8% of the households were female headed but also had an adult male decision maker. The majority (88%) of the households were involved in farming as their main source of livelihood, which was also the main occupation of women and men in the sample households. The average household size was seven persons. On average, the interviewed men were older than women at 48 and 45 years of age. The men were more educated (eight years of formal education) than the women (seven years of formal education). On average, the households had access to about 7.4 acres of land, out of which 4.6 acres on average were utilised for crop production with 1.4 acres allocated to banana production.

Table 1. Demographic and socio-economic characteristics of survey respondents and households.

Individual and Household-Level Variables	Scenario I: Gender Blind		Scenario II: Sex Disaggregated	
	Pooled Sample (N = 174)	Women (N = 87)	Men (N = 87)	<i>t</i> -Test
Age (years)	46.57 (16.49)	45.18 (13.47)	47.97 (19.00)	1.1132 (0.1336)
Education (years of schooling)	7.22 (3.61)	6.50 (3.50)	7.94 (3.58)	2.6750 (0.0041)
Average household size (number of people)	7.24 (3.53)	7.52 (3.86)	7.09 (3.35)	−0.5383 (0.7041)
Household type (%)				
Dual (male and female spouse)	81.05	61.17	94.08	
Female headed with another adult male decision maker	11.79	29.79	0.00	
Male headed with another adult female decision maker	0.84	0.00	1.39	
Female headed, without any adult male decision maker	2.53	5.85	0.35	
Male headed with more than one wife	3.79	3.19	4.18	
Main occupation (%)				
Farming	88.04	88.89	87.5	
Non-farm employment	8.70	8.33	8.93	
None	3.26	2.78	3.57	
Land access and utilisation by the household (acres)				
Land owned	6.75 (20.55)	4.91 (4.19)	7.92 (26.06)	0.6860 (0.2472)
Land rented	0.63 (1.38)	0.63 (1.37)	0.62 (1.39)	−0.0310 (0.5123)
Total land accessed	7.38 (20.51)	5.54 (4.22)	8.54 (26.00)	0.6855 (0.2474)
Allocated to crop production	4.64 (5.03)	4.09 (2.69)	4.99 (6.5)	0.8420 (0.2010)
Allocated to banana production	1.38 (1.87)	1.50 (1.44)	1.32 (2.11)	−0.4616 (0.6773)
Number of plots cultivated	3.94 (1.78)	4.11 (1.75)	3.84 (1.80)	−0.7089 (0.7599)
Main decision maker on marketable banana varieties (%)				
Husband	25.28	14.94	35.63	
Wife	32.76	45.98	19.54	
Jointly husband and wife	37.93	37.93	37.93	
Daughter	1.15	1.15	1.15	
Other male household member	0.57	0.00	1.15	
Other female household member	2.3	0.00	4.60	
Main decision maker on consumption varieties (%)				
Husband	20.68	14.94	26.44	
Wife	34.48	50.57	18.39	
Jointly husband and wife	39.66	32.18	47.13	
Daughter	1.72	1.15	2.30	
Other male household member	1.15	1.15	1.15	
Other female household member	2.30	0.00	4.60	
Grows <i>matooke</i> hybrids (%)	14.45	16.09	12.79	
Number of years growing hybrids	5.24 (4.12)	5.93 (4.80)	4.36 (3.04)	−0.9415 (0.8219)

Standard deviations in parentheses.

A two-sample *t*-test performed to compare demographic characteristics of men and women showed a significant difference only in the years of schooling: $t(172) = 2.6750$, $p = 0.0041$, with men on average reporting more years of schooling than women respondents.

Most of the sensory evaluation panellists were women (67%), while this was 33% for men. On average, the panellists were 47 years old (Table 2). Men had a slightly higher level of education, with 47.4% reporting secondary education, compared to women who mainly reported upper primary education (38.5%). Most panellists were married (56.9%) across gender categories. Approximately 20.5% of the women were widowed, and 21.1% of the men were separated/divorced. Farming was the main occupation for both women (92.3%) and men (89.5%) who participated in sensory evaluations.

Table 2. Demographic characteristics of the sensory evaluation panellists.

Variable	Pooled Sample (N = 58)	Women (N = 39)	Men (N = 19)
Sex (%)	-	67.24	32.76
Age (years)	46.79	46.87	46.63
Level of education (%)			
Upper primary	34.48	38.46	26.32
Secondary	31.03	23.08	47.37
Tertiary (college/university)	25.86	25.64	26.32
None	3.45	5.13	0
Lower primary	5.17	7.69	0
Marital status (%)			
Married	56.90	51.28	68.42
Separated/divorced	18.97	17.95	21.05
Widowed	15.52	20.51	5.26
Single	8.62	10.26	5.26
Primary source of income (%)			
Farming	91.38	92.31	89.47
Teacher	3.45	2.56	5.26
Business	3.45	5.13	0.00
Driver	1.72	0.00	5.26

3.2. Preferences for Cooking Banana (Matooke) Varieties

Survey respondents were asked to rank their five most important varieties for (a) production, (b) marketing, and (c) consumption on a scale of 1–5, where 1 = most important and 5 = least important.

3.2.1. Scenario 1: Gender-Blind Results for Farmer Preferences for Cooking Banana Varieties

Figure 1 shows the gender-blind ranking profiles of banana varieties for production, consumption, and marketing. The results showed that farmers preferred to produce traditional *matooke* cultivars, including *Mpologoma* and *Nakitembe*, which were considered the most important because of their taste and bunch size, respectively. These attributes can also explain the selection criteria for the most commonly grown banana varieties for food consumption and marketing. Our findings resonate with those of Mulugo et al. [22], who reported that farmers may prefer to grow specific cultivars for their own consumption and the market. While the cultivars for family consumption may not be high yielding, they may be preferred for their taste, colour (yellowish), and texture (soft), conditioned by the cultural context in which these cultivars are grown. However, such a gender-blind scenario does not paint a clear picture of preferences for the different gender categories as a key step in the prioritisation and setting of breeding objectives.

3.2.2. Scenario 2: Gender-Differentiated Results for Farmer Preferences for Cooking Banana Varieties

The sex-disaggregated profiles on how women and men ranked the varieties for production, consumption, and marketing show that significant differences exist in the

women and men rankings of varietal preferences (Figure 1). Significant differences exist in the ranking of the *Mpologoma* variety as a production variety between women and men, whereby men expressed a higher preference for *Mpologoma* than women. For market-preferred varieties, data on four varieties, namely *Nakitembe*, *Mpologoma*, *Musakala*, and *Kisansa*, provided sufficient degrees of freedom to conduct comparison tests. However, we found no significant difference between women and men in their choices of a market variety. This may imply that when it comes to choosing varieties to grow for the market, market forces tend to supersede farmers’ choices, whether by women or men. For consumption-preferred varieties, the difference in the ranking was only significant for *Kibuzi*, with men having a greater preference than women. *Kibuzi* has tightly packed fingers and provides more food per bunch than other varieties in its size range.

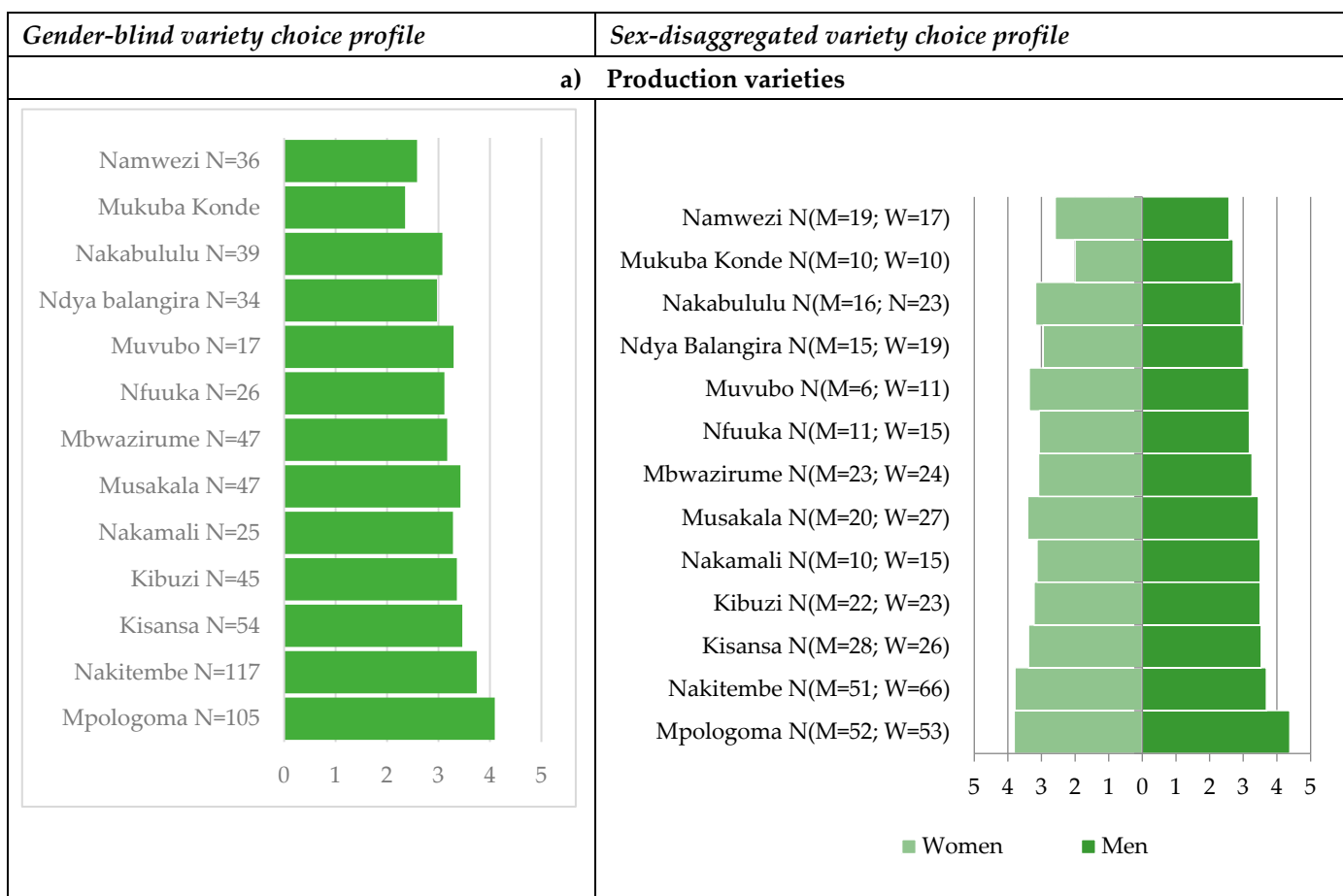


Figure 1. Cont.

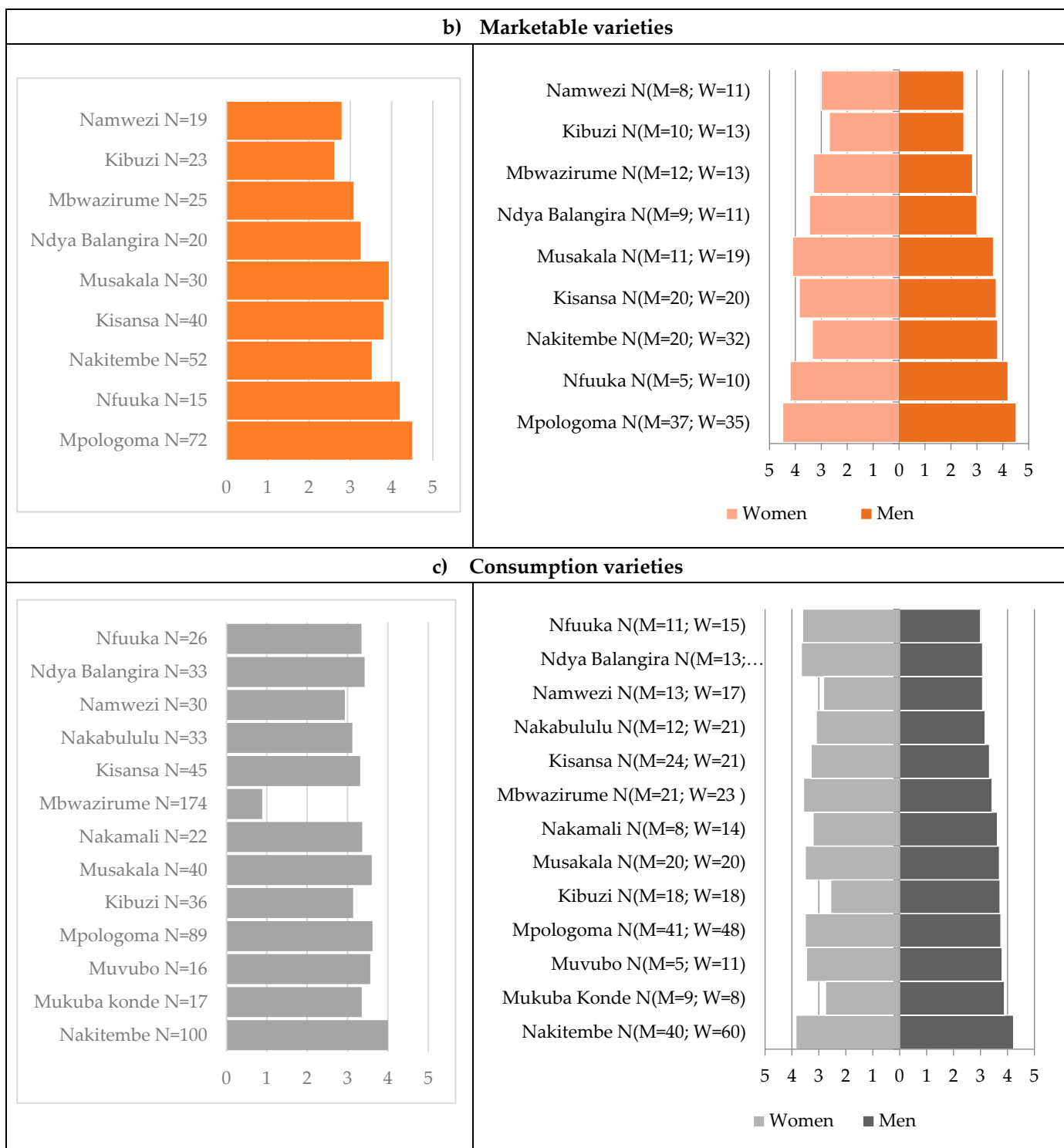


Figure 1. Preferences for cooking banana varieties for (a) production, (b) marketing, and (c) consumption by women and men. Note: all presented varieties are local/traditional. Source: survey data, 2017.

Although not mentioned among the most important varieties for production, consumption, and marketing, eight (8) *matooke* hybrid varieties were reported to be grown by approximately 14.4% of the farmers in the study (Figure 2). This result suggests that both women and men farmers in Central Uganda prefer traditional cultivars because of their superior attributes compared to new cultivars (*matooke* hybrids). Other studies also indicate that consumer preferences drive much of the varietal change in root, tuber, and

banana crops (RTB), either through characteristics attractive to consumers that increase adoption or unattractive traits that limit uptake [37]. Furthermore, farmers reported that the hybrids were mainly grown for home consumption (food security), rather than marketing. This preference could be explained by the adaptive strategies adopted by women to tailor *matooke* hybrids to their needs and conditions and continue to innovate with diverse utilisation. In a study by [38], farmers reported changes in preparation and cooking methods to enrich the texture and flavour of *matooke* hybrids, that is, mixed with the locally preferred cultivars at a ratio of 1:2 when cooking, fingers split in the middle after peeling to reduce hardness, and washed to reduce the sap (a myth perceived to shorten the longevity of a banana plantation), while others stored the bunch for about 3–4 days after harvest and before cooking to reduce the amount of sap.

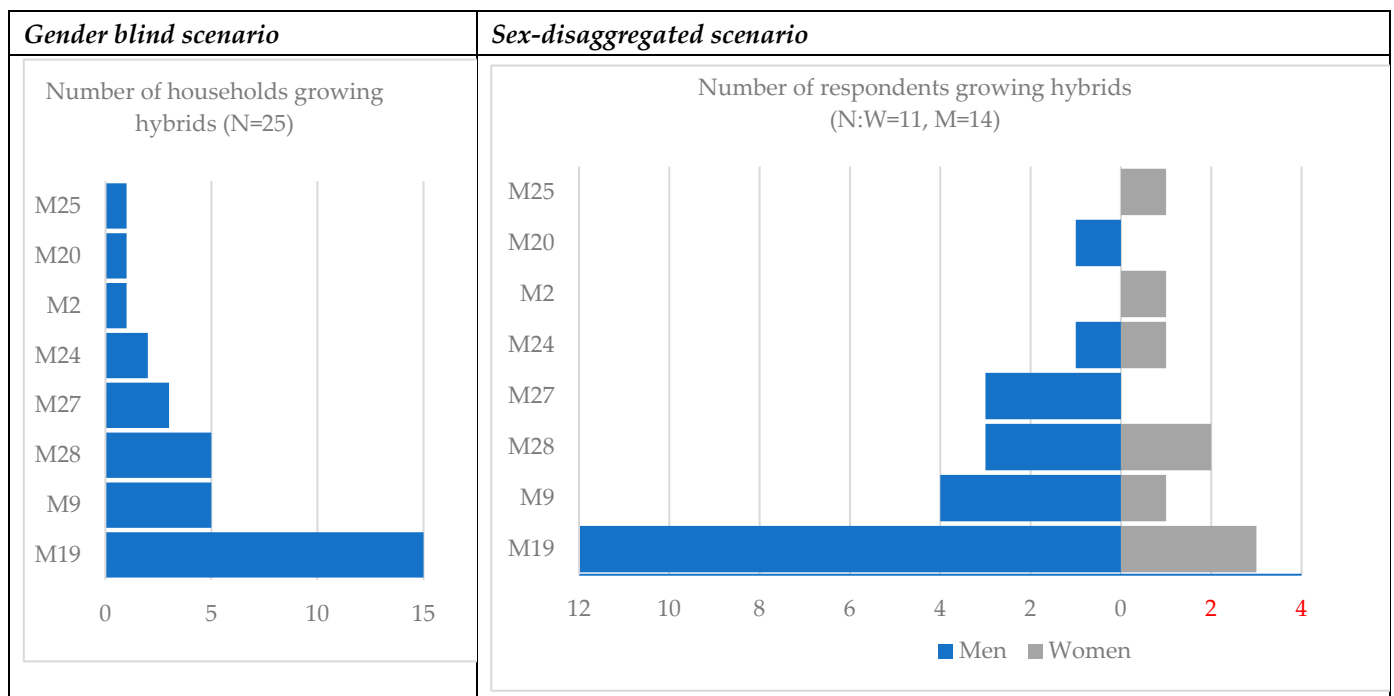


Figure 2. Frequency of response for the matooke hybrids grown; N = 25. Note: all presented varieties are improved/*matooke* hybrids. Source: survey data, 2017.

3.3. Most Important Attributes for *Matooke* Hybrids

3.3.1. Scenario 1: Gender-Blind Results for Analysis of the Most Important Attributes

Only 25 (14.4%) of the 174 respondents reported growing *matooke* hybrids; the average number of years of growth was six, and none of these households had found a need to discontinue growing the hybrids by the time of the survey. Tolerance to drought (68%) and resistance to pests and diseases (44%) were the most important attributes influencing the growth of the *matooke* hybrids (Table 3). This result is in line with an early study by [13] that alluded to the fact that the prioritisation of *matooke* hybrids during evaluation and selection was mainly based on technical production attributes related to agronomic and environmental traits. Consequently, farmers who grow *matooke* hybrids are motivated by their better agronomic and host resistance characteristics [20,39]. Other studies have also shown that farmers adopt new varieties if they are perceived to provide additional benefits such as higher productivity, yield stability, better taste and quality, or increased market value [40].

Table 3. Most important attributes that motivate growing of *matooke* hybrids in Central Uganda.

Most Important Attribute	Percentage of Responses (%)		
	Scenario I: Gender Blind	Scenario II: Sex-Disaggregated	
	Pooled Sample (N = 25)	Women (N = 11)	Men (N = 14)
Tolerance to drought	68	27	100
Tolerance to pests and diseases	44	18	64
Taste	32	36	29
Bunch size	16	27	7
Tolerance to poor soils	4	0	7
Texture (Softness) when cooked	4	9	0

3.3.2. Scenario 2: Gender-Differentiated Results for Analysis of the Most Important Attributes

When disaggregated by sex, the results indicated that the women selected *matooke* hybrids that had better taste, desired bunch size, and texture (softness) when cooked, while the men's selection was largely informed by tolerance to drought, pests and diseases, and taste. These results are consistent with those of the women-and-men-only group interviews: *"the improved varieties always have a big bunch and mature very fast . . . one bunch is big enough to feed my big family"* (women participants, women-only group interview, Kawongo village, Kimenyedde sub-county, Mukono district, 26 January 2017). According to one male participant, *"There should be food in the house always, and the local matooke varieties are not durable in terms of food security"* (male participant, men only group interview, Kawongo village, Kimenyedde sub-county, Mukono district, 26 January 2017). However, the men recommended that further breeding efforts are needed to enhance the taste, texture, flavour, and colour of food. We found that disaggregation by gender has the potential to inform breeders of gender-specific needs and preferences that can guide the prioritisation of the banana-breeding pipeline.

3.4. Traits Influencing the Acceptability of Cooking Banana Varieties by Women and Men Farmers and Consumers

3.4.1. Scenario 1: Gender-Blind Results for Traits Influencing Acceptability

In this study, we aimed to identify traits that shape the acceptability of cooking bananas through multiple methods as a strategy to triangulate the results. During the structured household interview, women and men farmers were asked to list and score the 10 most important attributes they considered when choosing a cooking banana variety to grow. Bunch size (77.6%), the taste of the food (70.1%), resistance to pests and diseases (47.1%), tolerance to drought (46.6%), and food texture/softness (42.0%) were ranked the highest across gender categories (Figure 3). The survey results corroborated the results of the pairwise ranking in the sex-disaggregated group interviews, in which the taste of the food of the cooking banana varieties was ranked as the most important attribute when choosing a cooking banana variety to grow by both women and men (Figure 4).

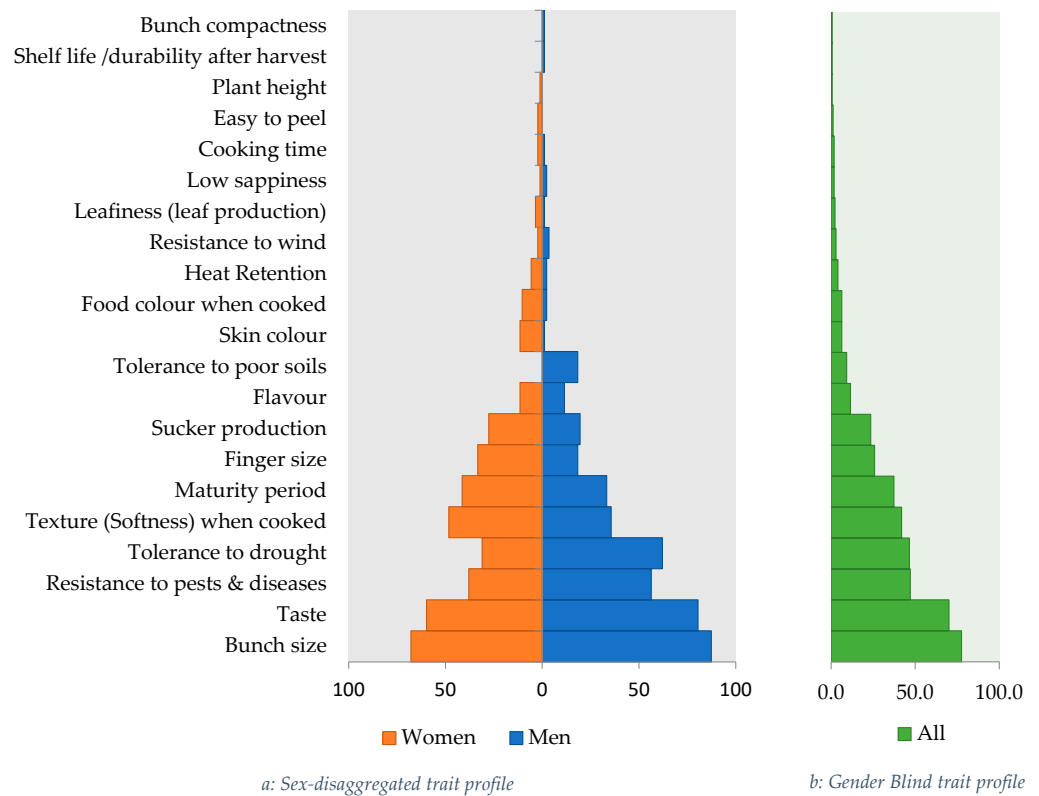


Figure 3. Mapping the banana trait preference profiles for men and women using two scenarios.



Figure 4. Radar diagram of the preference scores for the pairwise ranking of cooking banana attributes by women and men farmers.

3.4.2. Scenario 2: Gender-Differentiated Results for Traits Influencing Acceptability

Further analysis of the farmer trait profiles by gender indicated that men appreciated agronomic and market-related traits, such as tolerance to drought and poor soils, bunch size and compactness, maturity period, and shelf life, while women valued processing and cooking traits such as flavour, food colour, ease of peeling, and finger size. In addition, women mentioned plant height. This corroborates with other studies that have shown that in Central Uganda, variety selection, in most cases, considers tolerance to marginal soils and drought-prevalent characteristics [41]. Only two traits (ease of peeling (1.1%) and plant height (0.6%)) were considered exclusively by women farmers. The ease of peeling is an important trait in food preparation, a role that is carried out mostly by women in Central Uganda. A similar study [42] on cassava found that traits such as “easy to peel” and those related to “food product quality” were more frequently prioritised by women than by men. The traits considered exclusively by men were tolerance to poor soils (6.3%), shelf life/durability after harvest (1.1%), and bunch compactness (1.1%). The shelf life or time taken to ripen after harvest and bunch compactness are important attributes in the transportation and marketing of bananas to distant markets using either lorry trucks or bicycles, and buyers regard them as important purchase factors. The results corroborate with those of similar studies which indicate that farmers’ selection of banana varieties is influenced by production and consumption attributes [13,20]. However, the results add to existing studies by highlighting the key traits of interest to women and men, as opposed to the extensive existing analysis that lumps these two categories as banana farmers (“gender-blind” trait profiling). This is in line with a recent systematic review of the existing literature on banana trait preferences which indicates a significant gap in the literature for studies that focus on gender-specific trait preferences [12].

When subjected to a two-tailed *t*-test, there was no significant difference between women and men in the mean weighted score for gendered production traits, except for resistance to pests and diseases, finger size, and the ability of the variety to produce suckers (Table 4). Women considered finger size more important than men. On the other hand, men considered resistance to pests and diseases and the variety’s ability to produce suckers more important than women. The key identified attributes are plausible for the gender-responsive breeding of cooking bananas.

Table 4. The weighted average score for the mean differences in ranking of trait preference for cooking bananas by men and women.

Attribute	Men		Women		Mean Difference	<i>t</i> -Statistics	<i>p</i> -Value
	Mean	Std. Dev.	Mean	Std. Dev.			
Bunch size	2.276	1.571	2.153	1.311	0.124	0.488	0.627
Taste	2.729	1.474	2.769	1.477	−0.041	−0.151	0.881
Resistance to pests and diseases	2.239	1.580	3.476	1.470	−1.341	−3.628	0.001
Tolerance to drought	2.370	1.508	2.889	2.025	−0.519	−1.297	0.198
Texture (Softness) when cooked	3.645	1.404	3.167	1.752	0.478	1.252	0.215
Maturity period	3.000	1.626	2.778	1.495	0.222	0.573	0.569
Finger size	4.000	1.211	3.172	1.560	0.828	1.836	0.073
Sucker production	3.412	1.064	4.417	1.442	−1.005	−2.438	0.019
Flavour	4.200	1.033	4.500	1.780	−0.300	−0.461	0.650
Food colour when cooked	5.000	1.414	5.889	1.900	−0.889	−0.614	0.555
Heat Retention	5.500	3.536	5.400	2.302	0.100	0.046	0.965

Source: survey data, 2017.

The results further indicated that most local cultivars were regarded as having preferred traits (Figure 5). Therefore, different banana varieties are valued for their diverse attributes, which offer farmers opportunities to meet various production objectives. The most important varieties perceived to pose desirable traits were *Nakitembe* and *Mpologoma*. These varieties are preferred mainly because of their superior taste and large bunch size.

Furthermore, *Nakitembe* is considered tolerant to drought, resistant to pests and diseases, has high sucker production ability, and has better flavour, while *Mpologoma* has a soft food texture, short period, and large finger size compared to other varieties (Figure 4). These attributes can also explain the selection criteria for the most commonly grown banana varieties for food consumption and marketing. This conforms to an earlier market study by [43], in which these two cultivars were ranked the highest among other varieties as the most preferred varieties in the market.

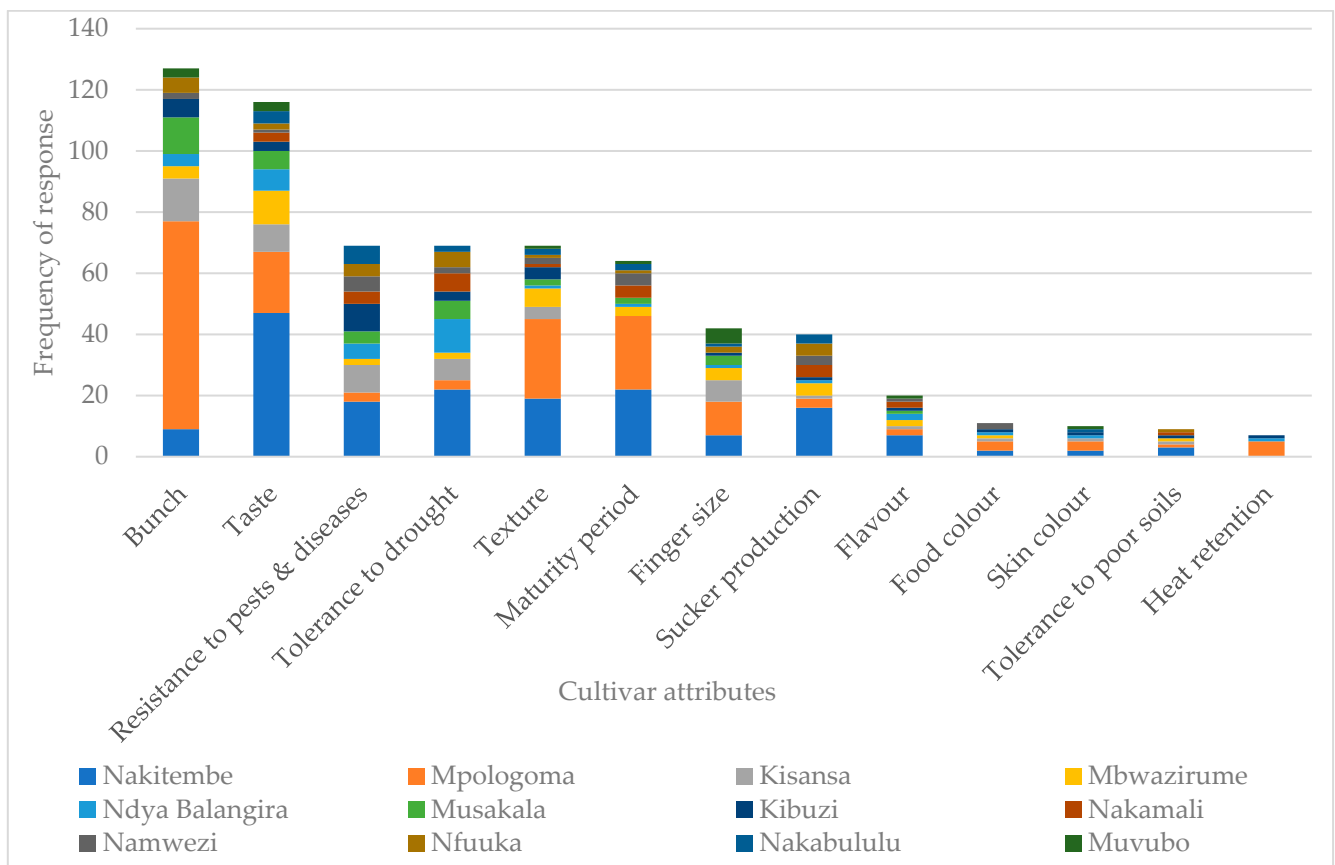


Figure 5. Main banana cultivars perceived to have preferred traits. Note: all presented varieties are local/traditional.

3.5. Assessment of Quality Traits Based on Sensory Evaluation Data Using the Gender-Blind and Gender-Differentiated Scenarios

The four *matooke* varieties: three hybrids (M27, M19, and M9) and *Nakitembe*, a local landrace preferred for its consumption characteristics (refer to Figure 5), varied considerably in acceptability as “food” when presented to panellists in steamed and pressed form for tasting during the sensory evaluations (Figure 6). Results of the sensory evaluation indicated that the taste of cooked *matooke* was the most important quality attribute for both women and men panellists (Figure 7). Taste still emerged as an important quality attribute across all the qualitative methods (FGDs, key informant interviews and group interviews) which revealed that consumers cannot compromise on the taste of *matooke*—“tokeness”. In fact, a cooking banana variety is defined by the taste of the food which can be referred to as its “tokeness” to emphasise the importance of this trait. The value that farmers attach to the taste of the *matooke* has also been demonstrated in other studies [17,44]. However, the taste was regarded to be influenced by a composite of quality attributes including flavour, appearance, and texture of cooked *matooke* as commented on by one of the key informants: “Before I even know the taste of the food, the flavour/aroma [good] and colour [yellow] will raise my anticipation of a good *matooke* taste” (a male key informant, Kimmenyedde sub-

county, Mukono district, 26 January 2017). Such quality attributes influence perceptions of improved banana varieties and consequently, inform adoption decisions s explained by one of the key informants below;

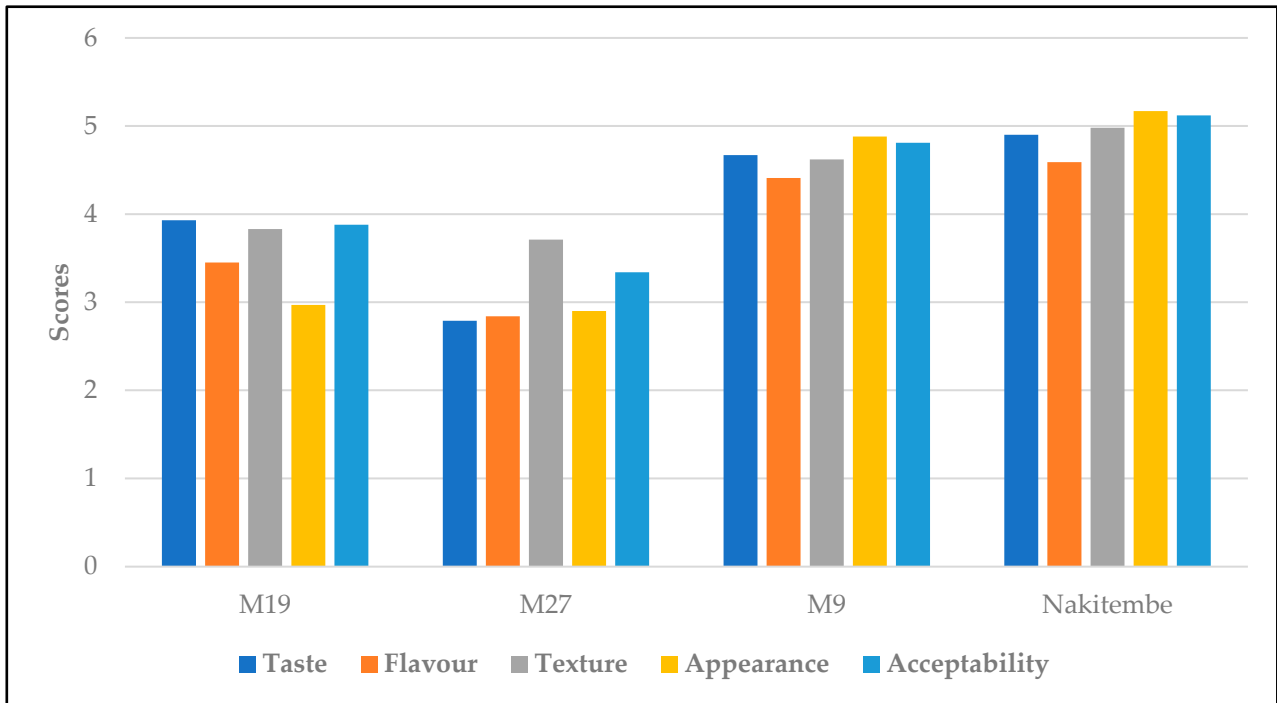


Figure 6. Mean scores for gender-blind sensory evaluation of quality attributes of *matooke* hybrids (M27, M19, M9) and the local landrace *Nakitembe*. Source: sensory evaluation data, 2017.

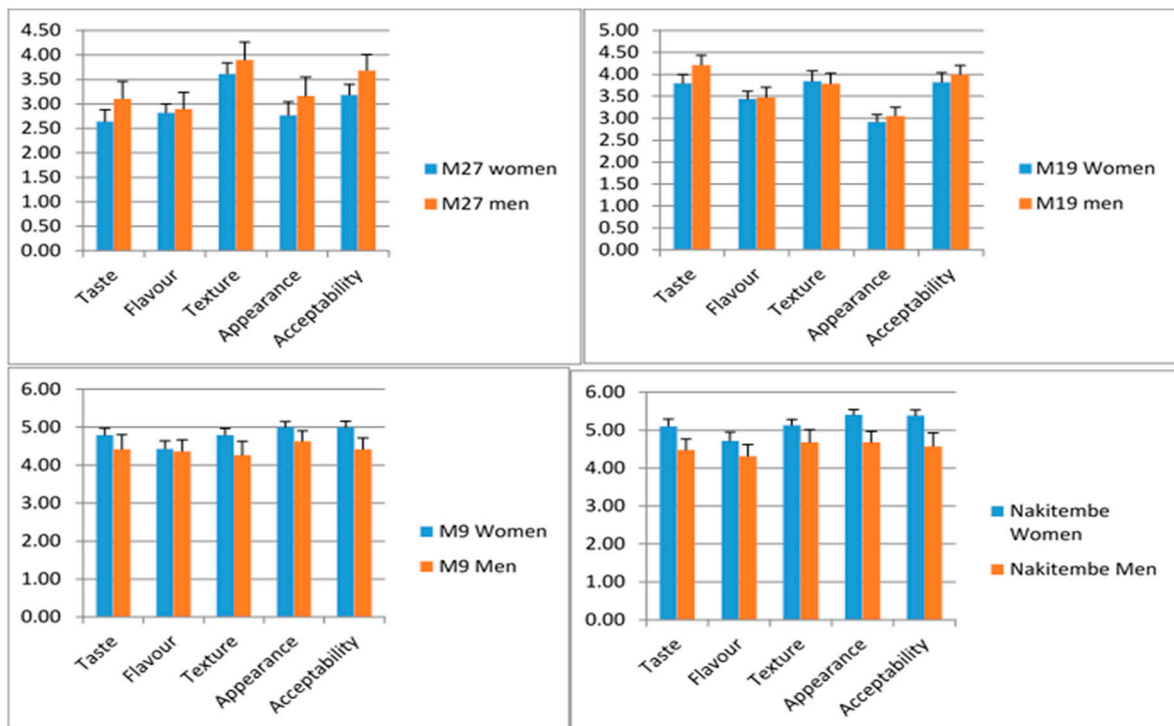


Figure 7. Mean scores for gender-differentiated sensory evaluation of quality attributes of *matooke* hybrids (M27, M19, M9) and the local landrace *Nakitembe* by women and men in Central Uganda. Source: sensory evaluation data, 2017.

“The improved bananas are negatively perceived because of their taste and flavour. A new variety with a large bunch but not tasty will not be accepted. In Buganda, we are very sensitive to the taste of the *matooke* and mostly treasure taste and flavour. We normally say ‘*ndiirabutafa*’ (meaning am only eating to survive) if a variety is not as tasty as our local *matooke*” (male key informant, Dekwa village, Namaliga Parish, Kimmenyedde sub-county, Mukono district, 27 January 2017).

Further, the results indicated no significant difference in the ratings between women and men and between different age groups (i.e., young women and men, elderly women and men, and adult women and men). Considering the mean sensory scores (Table 5), the women ranked most of the sensory parameters highly as compared to men but with no significant difference (LSD at 5%). This means that both women and men irrespective of age value these quality parameters or attributes equally in accepting new *matooke* hybrids; hence, such parameters should be considered important during breeding.

Table 5. Aggregate mean scores for the sensory quality attributes of *matooke* varieties.

Gender *	Colour	Flavour	Taste	Texture	Acceptability
Women	4.064	3.769	3.915	4.216	4.144
Men	3.805	3.667	4.004	4.059	4.005
Adult women	3.641	3.707	3.557	3.993	3.940
Adult men	4.041	3.709	4.191	4.353	4.121
Elderly women	4.301	3.729	3.888	4.377	4.144
Elderly men	3.097	3.836	3.690	3.547	3.760
Young women	4.237	3.826	4.362	4.179	4.321
Young men	4.143	3.487	3.973	4.062	4.196

* Young men and women (35 and below); adult men and women (36 to 55); elderly men and women (56 and above).

The overall acceptability scores did not vary significantly ($p = 0.05$) between the women and men. This implies that although the *matooke* hybrids had intrinsic differences in sensory attributes (taste, flavour, texture, and appearance), both women and men appreciated or expressed dissatisfaction when presented with food samples. There is conflicting evidence for gender differences in the preference for sensory attributes of food. For instance, researchers found no significant differences in the perception of sweetness between women and men [45–48]. In contrast, evidence supporting differences in taste ratings between women and men has been reported [49,50]. However, it is important to recognise that taste preferences and hedonic ratings may be influenced by many factors, such as emotional responses associated with past experiences and the willingness of the panellist to make trade-offs regarding what is acceptable. The fact that no significant differences were observed between women and men when scoring food samples of *matooke* varieties could be attributed to the fact that *matooke* is a staple food crop that is readily appreciated by most members of the traditional *matooke* eating community.

Unlike men, women also looked out for food processing- and consumption-related traits such as level of sap content, pulp colour, flavour, texture, finger shape, and cooking time for a particular variety, as explained below.

“There is a difference in choices between women and men for example women don’t like *Nakabululu* because of the finger size yet men don’t mind it since peeling is mainly done by women” (male key informant, Kaamakaganjo village, Kimenyedde sub-county Mukono district, 27 January 2017).

“I only eat soft food at my home. I cannot have food of hard texture *matooke*. Even though the bunch size is big but the taste is poor, I can’t go for that variety” (female farmer, women only group interview, Kawongo village, Kimenyedde sub-county, Mukono district, 26 January 2017).

Women predominantly take on a food preparation role which could explain their preference for such processing and consumption attributes. Similar studies indicate that women tend to pay more attention to postharvest processing and food quality characteristics in

a range of crops; hence, gender-specific characteristics should be considered to improve varietal acceptance and end-user benefits [8]. A recent review of the existing literature on gendered trait preferences for banana cultivation and use [12] indicates that such consumption and processing attributes are poorly understood in terms of assessment (measurement), inheritance, and their physicochemical nature; hence, there is a need for physicochemical characterisation, molecular assessments, and interdisciplinary work with food scientists and geneticists to increase the options for inclusion of such traits in banana breeding. As highlighted by [51], such efforts require continued capacity building at different levels to facilitate gender integration and gender responsiveness if intended breeding and equality outcomes are to be achieved.

4. Conclusions and Implications

This case study identified the most important traits for Ugandan women and men banana farmers and consumers to inform current and future national breeding programs for improved uptake and adoption. An effective gender-responsive breeding program needs to be based on a clear identification of the perceived constraints and trait preferences of women and men, and other intersectional social categories. We conclude that the taste of the food of a cooking banana variety is the most important trait for both women and men and determines whether or not a banana variety will be adopted in Central Uganda. Most adult consumers of cooking bananas cannot compromise the taste of *matooke*—“tokeness”. Breeding programs for *matooke* should invest in defining the compound(s) which determine the “tokeness” of cooking bananas. Once identified, such compounds might serve as a tool to guide the selection of lines in the early breeding stages, thus saving costs by reducing the cycles of evaluation of materials that may not be acceptable. This could also contribute to the shortening of the breeding cycle.

Similar to taste, most traits were equally appreciated by both women and men farmers and consumers. However, there was a greater appreciation for production (agronomic)- and market-related traits, such as tolerance to drought, tolerance to poor soils, bunch size, maturity period, and shelf life of harvested bunches by men. On the other hand, there was a greater appreciation of food quality traits, such as the flavour and colour of the food cooked by women. In addition, the results highlighted three traits (finger size, ease of peeling, and plant height) that were more appreciated by women farmers. These are plausible attributes for gender-responsive breeding in bananas. However, it should be noted that these gender-responsive traits should build on already high-priority traits such as taste. Breeding programs should recognise these traits as important and should consider them when defining new banana hybrid product profiles that guide breeding bananas.

Considering the challenges associated with banana breeding, such as the low genetic variability, polyploidy nature, low levels of female and/or male fertility, and high cost due to space and time requirements, the national banana-breeding pipeline should be redesigned to deliver varieties with a wider profile of attributes desired by women and men. We recommend stepwise selection criteria which begin with selecting hybrids for food quality-related traits such as taste, flavour, texture, and food appearance, followed by production (or agronomic)-related traits such as resistance to pests and diseases, tolerance to drought, tolerance to poor soils, maturity period, and sucker production. Since most adult *matooke* consumers are not willing to compromise on food quality traits, it might be a waste of valuable resources and time to advance *matooke* hybrids for further evaluation that are eventually not accepted and adopted by end- users, for both women and men. However, further research on bananas needs to shift in focus to interrogate other social identities that interact with gender to shape trait preferences and the acceptability of new varieties.

This study revealed the most important attributes of women and men farmers in Central Uganda when selecting a variety of cooking bananas. Breeding programs should consider gender differences when setting priorities and targets for breeding if they are to be more impactful. Involving women and men in this long journey to new banana varieties

could also bring more appropriate varieties with the potential to transform existing social norms. Women and men end users should be involved earlier in the breeding process to ensure that their preferences and needs are considered. Late or lack of involvement of women and men as well as gender-blind approaches might result in lower-than-expected adoption rates as important gender-specific traits might not be incorporated during the breeding process. Although most attributes appeal to both women and men in almost equal ways, the ranking of traits can be a good guide for streamlining banana breeding. Understanding how the different needs and preferences shape the acceptability of cooking banana varieties by women and men value chain actors should be a good precursor to a participatory, demand-driven, and gender-responsive banana-breeding process.

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