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DO FARMERS' PRODUCTION AND CONSUMER UTILIZATION OF SWEET POTATO MATCH? A CASE OF THE ROLE OF EXTENSION IN HOMABAY AND KISUMU COUNTIES, KENYA

Omondi IA[1]*, Maina SW[1], Moyo M[2] and T Muzhingi[2]

Idah Akoth Omondi

*Corresponding author email: idahomondi@gmail.com

[1]Department of Agricultural Education and Extension, Egerton University, Njoro, Kenya

[2]International Potato Center (CIP), Sub-Sahara Africa Region Office, Nairobi, Kenya

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ABSTRACT

The concept of extension services has changed over time with technology playing a key role, more emphasis is being placed on expanding the skills and knowledge of farmers in achieving food security and creating more proficient food products that meet consumer demand. Farmers and consumers utilize sweet potato in different ways, including boiling, steaming, roasting and frying the fresh roots. However, it remains unknown whether what is produced by farmers align to what is demanded by consumers and the role of extension in bridging the demand-supply gaps if it exists. Thus, the study assessed the role of extension in promoting sweet potato product utilization among farmers and consumers in Homabay and Kisumu County of Kenya. Mixed sampling procedures were applied to select 120 respondents who participated in the study: 52 farmers and 68 consumers of sweet potato. Data collected using a semi-structured questionnaire were cross-tabulated and responses subjected to independent samples t-test and chi-square test of significance. The results revealed SPK 004 and SPK 20 as the most planted and consumed varieties. There were significant differences in sweet potato trait preference between farmers and consumer. While significantly higher percentage (73%) of farmers considered colour when selecting varieties to produce for domestic sale and domestic consumption, equal percentage (43%) of consumers preferred colour and taste. Raw sweet potato was the most produced and bought sweet potato product for consumption with no significant differences by respondent type and county. Salient find of the study was that extension mediated sweet potato products produced, marketed, and consumed by farmers and consumers. Sweet potato products demanded by consumer matched products that were produced, sold, and consumed by farmers. Therefore, extensionist should be strengthened to effectively promote and dissemination sweet potato varieties and products with desirable traits both to farmers and consumers.

Key words: Sweet potato products, Extension role, Utilization, Consumer, Farmer, Value-added- products

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INTRODUCTION

Sweet potato [Ipomea batatas L] is classified as the seventh most produced crop in the world [1], with 89 million tons of the root crop produced from 7.4 million ha in 2020 [2]. The crop originated from Latin and Central America spreading across the world beginning in the sixteenth century. It was the main food crop during the American civil war and a crucial part of the slave population diet in the southern states [3]. China is the largest producer of, accounting for about 71 percent of global production. Out of the China's total produce, 51 percent is used as animal feed whilst 44 percent is utilized for human consumption [4]. Nigeria, Tanzania, Ethiopia, Rwanda, Uganda, and Kenya are the largest sweet potato producers in sub-Saharan Africa [5].

Specifically, Kenya is the seventh largest sweet potato producing country in sub-Saharan Africa, with an average yield of 8.2 tons/ha against a potential of 50 tons/ha [6]. Sweet potato farming in Kenya has grown tremendously over the last decades [7]. The main sweet potato varieties that are produced and consumed in Kenya are roots that are mainly boiled. The roots can also steamed, flour, fried, or roasted and also steamed and mashed to make a puree as forms of value addition [8] However, the level of utilization sweet potato products varies by agro-ecological region.

Sweet potato is mostly grown in the Lake Victoria region, Rift Valley, coastal and central region of Kenya. Several improved varieties with different flesh colours such as white, cream, yellow, orange and purple are grown under different agro-ecological zones [9]. Homabay County is the core of sweet potato production in Kenya, with Rachuonyo South, Rachuonyo East and Ndhiwa sub-county being the major producing areas [10]. These areas benefit from agricultural extension services which ensure timely dissemination of knowledge, technologies, and practices to achieve and maintain high yields. Therefore, extension of is a critical building block for not only raising sweet potato productivity but also creating awareness about utilization and nutrition.

The concept of extension services has changed over time. Although the technology transfer is still a key role of extension, more emphasis is being placed on expanding the skills and knowledge of farmers, enhancing rural livelihoods, achieving food security, and creating more proficient food products that meet market demand [11, 12]. Consequently, extension agents are the focal points that dissemination sweet potato production and consumption information beyond the farm.

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The unending challenge of malnutrition in Kenya compelled the government of Kenya through the ministry of agricultural partnerships with research organizations and private sector promote production and consumption of sweet potato [13]. An elaborate extension system was set up to disseminate information about the Orange-fleshed sweet potato (OFSP) varieties in major sweet potato production and consumption hubs [13]. For instance, the Sweet potato Action for Security and Health in Africa (MAMA SASHA) promoted production of SPK004 and Zapallo OFSP varieties in Western Kenya following moderate favourable consumer acceptance of the varieties [13,14]. Extension information was propagated via several channels to reach farmers and consumers. In anticipation of increased production, value addition technologies accompanied the intervention to expand utilization in both rural and urban area and expand market. Information about nutrition value of OFSP targeted farmers and producers and consumers in rural and urban area within the region.

The promotion of OFSP commenced almost 15 years ago yet reports indicate that farmers in western Kenya counties have not receive full value for their production. At the same time, sweet potato value added products remain scarce in rural and urban markets in western Kenya despite rapid extension that targeted producers and consumers in the region. Nonetheless, to the knowledge of the authors of this paper, there is limited information about the role of extension in increase sweet potato utilization at farm and consumption level in western Kenya. It is against this backdrop that the study focused on utilization of sweet potato products at farm and consumer levels and the role of extension in matching supply to demand of sweet potato products.

Furthermore, extension-farmer linkages are cited in literature as being crucial in building social relations which influence new technology adoption [15][16][17]. Mazuze [18], found evidence that access to extension enhanced acceptance of orange-fleshed sweet potato in Mozambique. However, evidence of extension-consumer linkage with respect to sweet potato products is missing in the literature. This study filled this gap by investigating the association between extension-farmer and extension-consumer linkages on the utilization of sweet potato product in two lakeside counties of Homabay and Kisumu in Kenya. The novelty of this study is that it links extension service to both production and consumption of sweet potato. Evidence generated will enhance sweet potato value chain by enabling agricultural extension services to prioritize end-to-end support structures that link sweet potato products at farm level to what is demanded at consumption level.

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MATERIALS AND METHODS

Study area

The study was conducted in Homabay and Kisumu counties in Western Kenya. Homabay County was the focus of the study since it is among the most populous places around Lake Victoria region known for sweet potato production and consumption [19]. Homabay and Kisumu Counties are located along the south shore of Lake Victoria. Homabay County covers an area of 3,183.3 sq. Km [20]. Kisumu Central covers the town area which is one of the major cities around Lake Victoria basin where most sweet potato products are sold [21].

Agriculture is the primary source of foods, income, and livelihoods in the two counties. Although Kisumu County host the third largest city in Kenya, the city is a largely rural city with agricultural production happening in the fringes of the city. Major food crops in the two countries are maize, beans, sweet potatoes, and vegetables. Climate is inland equatorial for both counties, with temperatures ranging from 17.1°C during the coolest month to 34.8°C during hottest months. Rainfall amounts received in Homabay County ranges between 250mm and 700mm per annum, which support agricultural production.

Sampling procedure and sample size

The study targeted smallholder sweet potato farmers and consumers in Homabay and Kisumu counties. The study defined a farmer as an economic agent that produces and utilizes sweet potato at home and sells in case of surplus production. The primary purpose of for sweet potato production is home consumption. Consumer is defined as households or individuals who largely but depend on the market to supply of sweet potato products. Consumer, especially in Kisumu city, may from time to time farm on open spaces to supplement household food supply from the market. Targeted farmers in Homabay were in Rachuonyo East, Rachuonyo South, and Ndhiwa, while consumers were drawn from areas classified as urban and peri-urban area in the county. Consumers in were from Kisumu Central which has Kisumu city as the urban area. Lists of farmers in Homabay were obtained from ward agricultural extension officer, while village administrators provided list of households in urban area. The respondents were either household heads or spouses because they control food budget and have monopoly over household production and consumption decisions. The two sets of lists formed sampling frames for farmers and consumers. Samples of farmers and consumers were randomly selected from the list using the RAND function in Excel. Probability proportional to size was used to apportion the number of farmers from sub-

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counties and villages. A total sample size of 120 was obtained: 52 farmers and 68 consumers.

Data Collection

Semi-structured survey questionnaires were used to collect quantitative data from farmers, consumers and key informants. The survey tool was structured into three parts. The first part was the demographic section that collected respondent identification and characteristics such as county, gender, age, marital status, and education. The second section collected information sweet potato characteristics, including products, varieties, traits, reasons for selection of varieties and products. The researcher used a checklist of varieties to correctly identify varieties utilized by farmers and consumers based on description provided by the respondents. The third section of the survey tool collected information related to extension and advisory services.

Data Analysis

The cleaned data were analysed using descriptive statistics such as mean, standard deviation, frequencies and percentages. Cross tabulation of participants was performed to obtain comparative counts and percentages of responses of categorical variables. The data was cross tabulated with type of respondent and county as column variables. Inferential statistics were then applied to test whether the existed any systematic differences in response by type of respondent and counties. Specifically, independent sample t-test was used to test for significance of the differences for continuous variables such as age. Differences in distribution of categorical variables were tested with Fisher's exact test when the count of any mutually exclusive group was less than five. Chi-square test of independence was used to test systematic differences of categorical variables when the counts in all cells are five or higher. The test was performed at 5% significance level. The results were tabulated and visualized for interpretation and presentation.

RESULTS AND DISCUSSION

The results of analysis of characteristics of participants in the study disaggregated by respondent type and county are presented in Table 1. The p-values for categorical variables (sex, marital status, and education levels) were obtained from chi-square test of independence and Fisher's exact test. Independent sample t-test was used to test whether there existed difference in average age of farmers by respondent type and counties.

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About 58% of participants in the study were male and 42% were female. Disaggregation of sex of participants by type of respondents showed that 77% and 23% of 52 farmers that participated in the study were male and female, respectively. On the other hand, 56% and 44% of consumers were female and male, respectively. The percentages of male and female farmers and consumers that participated in the study were statistically significantly different ($p < 0.01$).

Fifty nine percent (59%) and 41% of surveyed respondents in Homabay were farmers and consumers respectively, all respondents (32) in Kisumu were consumers. This result was expected because Kisumu City, a major regional economic hub located in Kisumu County, is characterized by rapid industrialization and urbanization. In contrast, Homabay County is a largely rural county dominated by agriculture as the main economic sector. The rise in urban population and changing consumer behaviour towards traditional and healthy foods are causing a rise in demand for root and tuber crops as substitute foods for processed wheat and maize products that are often unaffordable.

Furthermore, results in Table 1 show that the average age of participants in the study was 46 years. The difference between the average ages of consumers (48 years) and farmers (43 years) was statistically significant ($p < 0.05$), suggesting that consumer respondents were older than farmer. The significant difference in age by respondent type is critical in understanding possible role of experience in participation in sweet potato value chain, which is an important dynamic in explaining possible differences in access to extension information on importance of production and utilization of sweet potato products.

The results in Table 1 also show that most respondents (82%) were married, 13% were single, and 6% were divorced and separated. Disaggregation of marital status by respondent type results show that 92% of farmers compared to 74% of consumers were married. The difference in marital status of farmers and consumers was statistically significant at 5% level. Marital status is critical in extension work for it influences who can be targeted to attend extension sessions. In the context of study area and MAMA SASHA project, women were most targeted because of they are mostly responsible for sweet potato production and utilization at household levels, and the most affected by malnutrition. However, gender roles disproportionately burden women and limit their mobility which has an implication on venues and timing of extension meetings when such events involve married women [22]. In contrast, single or separated women may also have greater mobility and may generally participate extension in meetings or make consumptions decision independently.

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From the result in Table 1, it shows that the marital status is a crucial consideration in extension services for it influences inclusion or marginalization of social groups of farmers. Specifically, marital status may influence the capacity of smallholder farmer to innovate due to differences in mobility that is necessary in attending extension meetings or going to the market. For instance, older married women may have relatively higher mobility to attend extension meetings or visit markets than young married women.

Analysis of educational attainment of participants revealed that 35% of respondents had secondary education level. About 21% and 23% of the respondents had no formal educational qualification and primary school level education, respectively. The percentage of respondents with post-secondary educational qualification was 21%. Extension is a package of services that besides creating farmers' awareness of farm technology and contributing to increased farm productivity, also assists farmers to learn about market trends in terms market-demanded products thereby enhancing farm revenues and minimizing food insecurity.

Education is an important determinant of farmer's awareness of possible sources of information and knowledge that is critical to making informed production, marketing, and consumption decisions. The type of information demanded by educated farmers and consumers could be critical in adoption of market-demand technologies and product. Gido *et al.* [23] found evidence that educational attainment increased farmers' demand for extension education, extensionists can leverage existing opportunities in terms on literate farmers to improve adoption, production, marketing, and consumption of sweet potato varieties and sweet potato products. Maake and Antwi [24], reported that education level of farmers positively influenced their perceptions of effectiveness of extension and advisory services, meaning that they can trust messages they receive from extension officers with respect to sweet potato products.

Farmers were also asked to report varieties that they planted and the traits they considered and results of analysis of their responses are presented in Table 2. Pooled results show that SPK 004 was the frequently grown and consumed sweet potato followed by SPK 20 (23%), Kemb 20 (17%), and Sura Mbaya (10%). Other planted and consumed varieties were Amina and Kalam as reported by 8% and 7% of the respondents, respectively. However, there were no statistically significant differences in varieties planted by farmers and consumed by consumers as indicated by p-value of 0.414 that was not significant at 5% level. Comparison of

results by county revealed the same patterns with most farmers in Kisumu (41%) and Homa Bay (34%) planting SPK 004, followed by SPK 20. About 19%, 17%, 11%, 10%, and 8% of farmers while farmers in Homabay planted and consumed SPK 20, Kemb 20, Sura Mbaya, Amina, and Kalam respectively compared to 34%, 16%, 6%, 0%, and 3% of farmers in Kisumu County, respectively. Nonetheless, there were no significant ($p < 0.221$) differences in proportions of respondents that planted the varieties between the two counties.

Furthermore, the results presented in Table 2 show that farmers considered the sweet potato varieties for utilization principally because of colour (56%). Other critical traits considered by respondents were taste (24%) and texture (12%) while fringe traits were floury consistency (5%) and smell (3%). There were statistically significant ($p < 0.01$) differences in traits preferred by consumers and farmers. While farmers considered only two sweet potato traits (colour, 73%: texture: 26%), consumers considered diverse traits, including colour (43%), taste (43%), floury consistency (9%), and smell (6%). The statistically significant differences in traits of sweet potato traits considered by farmers and consumers can be explained within the realms of theory of the producer-consumer household. According to Maruyama and Sonoda [25], a household, especially an agricultural household, engages in both production and consumption decisions. Therefore, they are both producers and consumers of products. In this study, farmers' sweet potato production and consumption decisions were possibly inseparable. Specifically, farmers planted varieties that met their production and consumption considerations which narrowed their choice set of traits. In contrast, consumers' preferences of sweet potato products differ [26] because they only must make consumption decision from available products. Consequently, consumers had a wider array of traits to select from than farmers.

Comparison of traits considered by respondents by geographical space revealed that while 63% of respondents in Homabay considered colour of sweet potato varieties, half of those in Kisumu focused on taste (Table 2). While taste (15%) was the second most frequent sweet potato trait considered by participants in Homabay, colour was the second most considered traits by about 38% of respondents in Kisumu County. Respondents in Homabay also considered, floury consistency (22%), and smell (1%), while 9% and 3% of respondents in the Kisumu considered smell and floury consistency, respectively (Table 2). These responses were statistically significant at 1%, meaning that traits considered by respondents vary over space. As earlier indicated in Table 1, Homabay had both farmers and consumers as respondents, while Kisumu had only consumers.

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Therefore, the statistically significant results were expected because the sample size in Homabay was heterogeneous with diverse trait consideration.
Figure 1 shows sweet potato products produced and bought by participants in the study disaggregated by respondent. Comparison by respondent type revealed raw sweet potato as the most produced product for farmers (52%) and the most bought (41%) products by consumers. One-quarter of farmers produced baked sweet potato products compared to 19% of consumers who bought baked sweet potato products. This show that some of the farmers embraced value addition of OFSP that was availed during the MAMA SASHA project. While 19% of farmers produced steamed/boiled sweet potato product, 38% of consumers bought the raw sweet potato. About 4% of farmers and 1% of consumers produced and bought fried sweet potato product. The proportion of farmers that produced and bought sweet potato products did not significantly differ as shown by statistically not significant Fisher's exact probability values, 0.118. This result implies that farmers produced met market-demand sweet potato products. The result suggests that farmers produce sweet potato products that match market or consumer demand for sweet potato products. Therefore, as observed by Shepherd [27] farmers' choice of products to produce should be based on market demand.

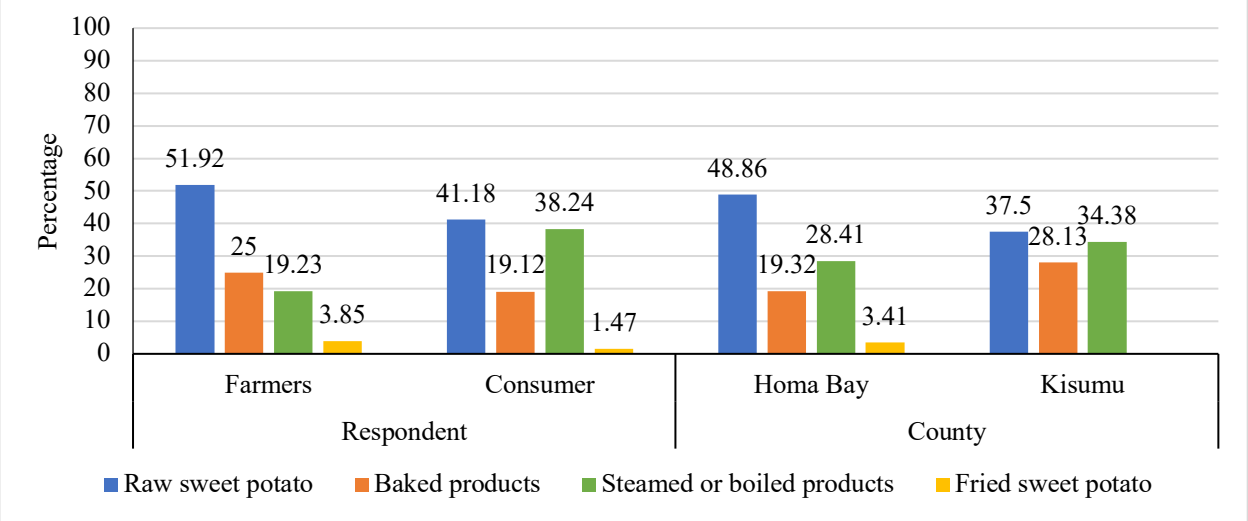

Figure 1: Sweet potato products produced by farmers and consumed by consumers by type of respondent type and county (Respondent type: Fisher's exact p-value = 0.118; County Fisher's exact = 0.498)

The results in Figure 1 also shows distribution of sweet potato products by county. 49% and 38% of participants in Homabay and Kisumu counties and 52% and 41% of farmers and consumers respectively produced and bought raw sweet potato, respectively. 19% of participants in Homabay compared to 28% in Kisumu bought baked sweet potato products. While 28% and 3% of respondents Homabay

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produced steamed/boiled and fried sweet potato products, about 28% and 34% of respondents in Kisumu bought the same products, respectively. Fisher's exact test of proportions test statistic (p=0.498) was not statically significant, meaning that there were no observable differences in sweet potato products produced and consumed in the two counties. This result shows that farmers are producing sweet potato products that meet products demanded by consumers regardless of where they reside.

Colour was the most considered trait of sweet potato products produced and consumed by participants. However, sweet potato varieties are often distinguished by colour of the root [39]. Therefore, it was critical to understand whether colours of sweet potato products produced and bought by respondents were the same for uncooked and cooked sweet potato. Most farmers reported that uncooked sweet potato was white (48%) in colour, followed by yellow (44%), and purple (8%). In comparison, 35%, 59%, and 6% of consumers said uncooked sweet potato were white, yellow, and purple, respectively. The proportions of farmers and consumers that reported that the colours of uncooked sweet potato were not statistically significantly different (p=0.273). For cooked sweet potato, 48% of farmers compared to 35% of consumers indicated that the colour of cooked sweet potato was white. 12% and 26% of farmers and consumers reported that cooked sweet potato was orange, respectively. Purple colour for cooked sweet potato was reported by 8% of farmers and 6% of consumers. Almost one third of farmers and consumers said that the colour of cooked sweet potato was orange. Also, the colour of cooked sweet potato did not significant differ by county (p=0.193). These findings indicate that colour of sweet potato produced and bought does not vary depending on respondent type irrespective of transformation (value addition) in type of product.

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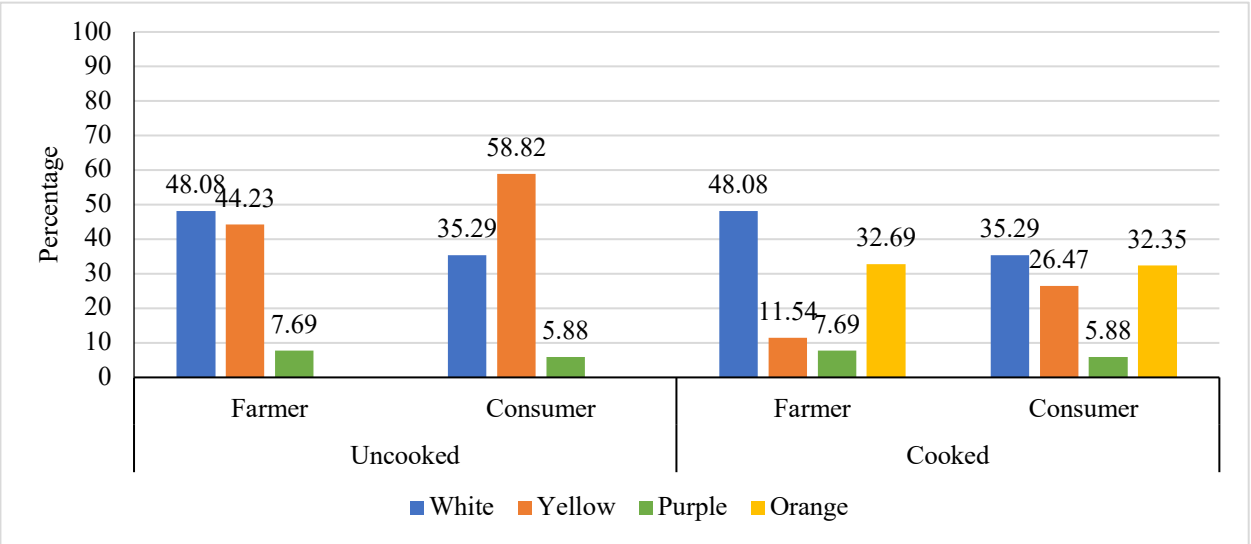

Figure 2: Colour of sweet potato varieties produced and consumed by type of respondent type (Uncooked: Fisher's exact p-value = 0.273; Cooked Fisher's exact = 0.193)

The study presents result of the role of extension in sweet potato utilization. Farmers and consumers were asked to report whether they were visited by extension officers and the results are shown in Figure 3. The results show that 25% of respondents were visited by extension officers. Fisher's exact test shows that statistically significantly ($p < 0.01$) higher percentage of farmers (56%) than consumers (3%) were visited by extension officers. This result could be explained by extension system in Kenya being farmer oriented. Meeting the changing demand patterns of farm products by consumers is complex constraints, including weak linkage to the market caused by limited or lack of market information. Agricultural extension workers can not only assist farmers identify buyers, but also advise them to develop new or improved products to meet consumer demand for products [28]. This observation highlights the critical role of extension services in linking farmers to buyers [29, 30].

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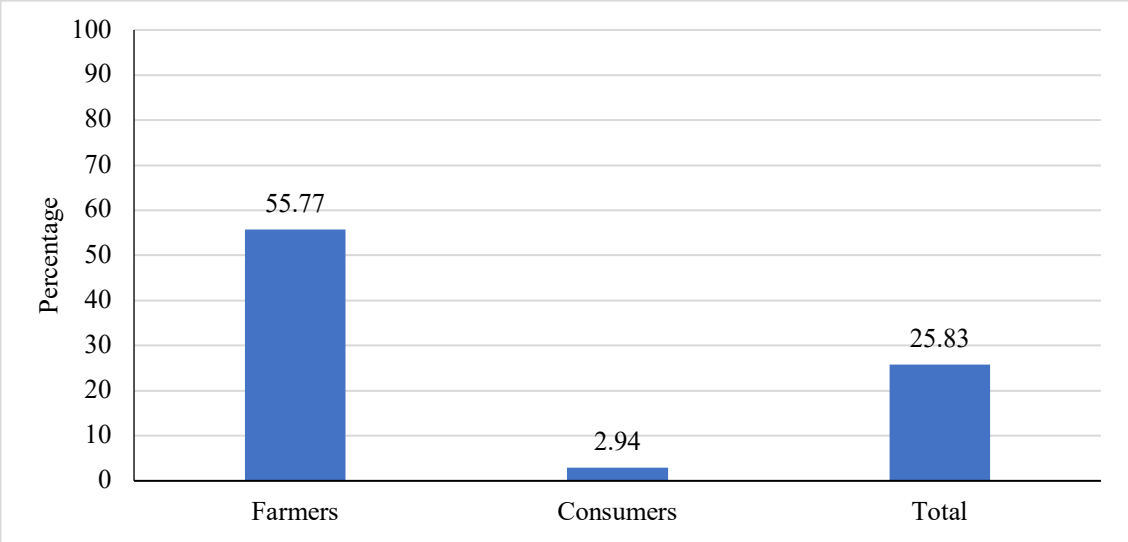

Figure 3: Percentage of respondents visited by extension officers (Fisher's exact p-value = 0.000)

The information delivered by extension agents is critical in enabling farmers make production decisions and consumer to make product choice decisions. In literature, farmers are reported to be persuaded to demand extension services to access sweet potato products [31]. As a result, extension agents receive specialized training to effectively promote and dissemination sweet potato varieties and products with desirable traits [32]. Particularly, the study analysed participant responses regarding whether extension covered sweet potato products and traits. The results in Table 3 show that 68% of participants that that were visited by extension officers received information about sweet potato products and traits from the agents. Further analysis revealed that 73% of farmers that were visited received information about sweet potato products and traits. On the other hand, 1 out of 2 consumers that were visited by extension officers received information about sweet potato products and traits. The percentages of farmers and consumers who received information about sweet potato products and traits was statistically significantly ($p < 0.041$) higher than those who did not receive. However, the percentage of participants in that reported that they were informed by extension officers about sweet potato products and traits did not significantly differ by county. These results possibly mean that whereas extension packaging of extension information about sweet potato and traits may depend on type of client, access to similar information is uniform across the two geographic area.

The results that were used to answer the third research question are presented in Table 4. Comparison of sweet potato products bought by farmers who were visited by extension agents and those who were not visited reveal that those who received extension information produced more products (4) than those who were not visited (3). 69% of farmers that received extension services produced raw sweet potato

for sale compared to 30% of those that were not visited. 48% and 22% of farmers who did not receive extension services produced baked and steamed/boiled products for sale compared to 7% and 17% of farmers that were visited by extensionists, respectively. Another 7% of farmers who were visited by extension officers produced fried sweet potato for sale. These results reveal that extension-farmer linkage influence the number and type of sweet potato products that farmer produce. The percentage of sweet potato products produced by farmers who received extension visits were significantly different from those that were not visited. The results conform to finding reported by Mudombi [33] who noted the production intensity of sweet potato product was positively associated with extension service. Therefore, extension does not only influence the type of products produced but the level of production.

Furthermore, comparison of consumer results by status of access to extension services showed recipients of the services bought more (4) sweet potato products than those non-recipient consumers (3 products). About 53%, 39%, and 7% of consumers that did not receive extension visits reported that they bought raw, steamed/boiled, and fried sweet potato, respectively. In comparison, of the 2 consumer recipients of extension services bought raw, baked, steamed/boiled, and fried sweet potato. The sweet potato products were statistically significantly different, meaning that consumers who received extension visits bought different products compared to those who were not visited by extension officers. This finding indicates that extension has a strong link with sweet potato bought by consumers. Therefore, making extension and advisory services sensitive to drivers of consumer demand for sweet potato is critical to delivering appropriate message about available products that can match consumer needs.

CONCLUSION

The study revealed relevant demographic characteristics that should be considered by extension agents when designing extension sessions to effectively reach the targeted participants in their programs. Age and marital status of significantly differed by respondent type, meaning that the extension officers need to profile their trainings and advisory services in such a way that they are reach the targeted people based on demographic characteristics. The study also reveals that the agricultural production roles is mostly dominated by men and consumption roles by women. This is supported by the fact that women had to seek permission from their husbands who are the owners of the land.

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The study also found that SPK 004 was the most frequently grown and consumed sweet potato followed by SPK 20 (23%), Kemb 20 (17%), and Sura Mbaya (10%). Other planted and consumed varieties were Amina and Kalam as reported by 8% and 7% respectively. The study concludes that farmers considered only two sweet potato traits (colour, 73%: texture: 26%), while consumers considered diverse traits, including colour (43%), taste (43%), floury (9%), and smell (6%).

Raw sweet potato as the most produced (52%) and bought (41%) by farmers and consumers compared to other products such as baked, steamed or boiled products. Consumers in Kisumu considered baked products most compared to those in Homabay County. Colour was the most considered trait of sweet potato products produced and consumed by participants.

Farmers (56%) than consumers (3%) were mostly visited by extension officers and the focus was on production decisions and consumer to make product choice decisions respectively. Therefore, extensionist could offer specialized training to effectively promote and dissemination sweet potato varieties and products with desirable traits both to farmers and consumers. The extension-farmer linkage influences the number and type of sweet potato products that farmer produce besides level of production.

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Table 1: Demographic characteristics of respondents disaggregated by respondent type and county

		Respondent Type		
	Total (N=120)	Farmers (n=52)	Consumers (n=68)	p
Percentage of respondent (%)				
Farmer	43.33			
Consumer	56.67			
Sex of respondent (%)				0.000
Male	58.33	76.92	44.12	
Female	41.67	23.08	55.88	
Av. age of respondent	45.74	43.23	47.66	0.049
	(12.23)	(11.03)	(12.82)	
Marital status (%)				0.018
Married	81.67	92.31	73.53	
Single	12.50	3.85	19.12	
Divorced/separated	5.83	3.85	7.35	
Education level (%)				0.06
No formal education	20.83	25.00	17.65	
Primary school	23.33	13.46	30.88	
Secondary school	35.00	44.23	27.94	
Collage and above	20.83	17.31	23.53	

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Table 2: Sweet potato varieties and trained by type of respondent

Variable	Total (N=120)	Respondent Type		p
		Farmers (n=52)	Consumers (n=68)	
Variety planted and consumed (%)				0.414
SPK 004	35.83	32.69	38.24	
SPK 20	23.33	23.08	23.53	
Kemb 20	16.67	11.54	20.59	
Sura Mbaya	10.00	15.38	5.88	
Amina	7.5	9.62	5.88	
Kalam	6.67	7.69	5.88	
Traits considered (%)				0.000
Colour	55.83	73.08	42.65	
Taste	24.17	0.00	42.65	
Texture	11.67	26.92	0.00	
Floury	5.00	0.00	8.82	
Smell	3.33	0.00	5.88	

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Table 3: Percentages of responses to whether extension training covers sweet potato products and traits by respondent type and county

	Yes	No	p-value
Total	68.33	31.67	
Respondent type			0.041
Farmers	73.07	26.93	
Consumers	64.71	35.29	
County			0.167
Homa Bay	57.95	42.05	
Kisumu	43.75	56.25	

Table 4: Role of extension of visits on products produced and bought by farmers and consumers

	Farmers			Consumer		
Product	Yes	No	p-value	Yes	No	p-value
Raw sweet potato	68.97	30.43	0.002	40.91	53.18	0.014
Baked products	6.9	47.83		39.39	0.00	
Steamed or boiled	17.24	21.74		18.88	39.39	
Fried sweet potato	6.9	0.00		0.82	7.43	

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REFERENCES

1. **FAO**. Shelley McGuire The State of Food Insecurity in the World 2015. Meeting the 2015 international hunger targets: taking stock of uneven progress. Food and Agriculture Organization Publications, 2016, Rome.

2. **FAOSTAT.** Crops and livestock products 2022. Retrieved from https://www.fao.org/faostat/en/#data/QCL *Accessed March 2022.*

3. **Loebenstein G and G Thottappilly** The sweet potato. Springer Science & Business Media, 2009.s.

4. **Akoetey W, Mead M, Ruben B and O Morawicki** Potential use of byproducts from cultivation and processing of sweet potatoes, 2017.

5. **Rybicki EPA** Top Ten list for economically important plant viruses. *Archives of Virology*, 2015; **160(1):** 17–20.

6. **Fatunbi O** Innovation Opportunities in Sweet Potato production in Kenya 2018.

7. **Mukras MS, Alphonce OJ and G Momanyi** Determinants of demand for sweet potatoes at the farm, retail and wholesale markets in Kenya 2013.

8. **Grace MH, Truong AN, Truong V, Raskin I and MA Lila** Novel value-added uses for sweet potato juice and flour in polyphenol-and protein-enriched functional food ingredients. *Food Science & Nutrition*, 2015; **3(5):** 415–424.

9. **Sugri I, Maalekuu BK, Gaveh E and F Kusi** Sweet Potato Value Chain Analysis Reveals Opportunities for Increased Income and Food Security in Northern Ghana, 2017.

10. **Ochieng LA, Githiri SM, Nyende BA and LK Murungi** A survey of farmers' perceptions and management strategies of the sweet potato weevil in Homa Bay County, Kenya. *African Journal of Food, Agriculture, Nutrition and Development,* 2017; **17(3):** 12157–12178.

11. **Swanson B** Global Review of Good Agricultural Extension and Advisory Service Practices. Food and Agriculture Organization of the United Nations. 2008, Rome, Italy.

12. **Kingiri A** Agricultural advisory and extension service approaches and inclusion in reaching out to Kenyan rural farmers. *African Journal of Science, Technology, Innovation and Development*, 2020: 1–10.

13. **Ndolo PJ, Nungo RA, Kapinga RE and S Agili** Development and promotion of orange-fleshed sweetpotato varieties in Western Kenya. In Proceedings of the 13th ISTRC Symposium 2007;(pp. 689-695). https://doi.org/10.3945/jn.116.236406

14. **Okello J, Muoki P, Kwikiriza N, Wambaya J and S Heck** Effect of agriculture-nutrition education and extension services on early adoption and diffusion of bio fortified crops, 2018.

15. **Mugumaarhahama Y, Mondo JM, Cokola MC, Ndjadi SS, Mutwedu VB, Kazamwali LM and GN Mushagalusa** Socio-economic drivers of improved sweet potato varieties adoption among smallholder farmers in South-Kivu Province, DR Congo. *Scientific African,* 2021; **12**(1-12). https://doi.org/10.1016/j.sciaf.2021.e00818

16. **Hainzer K, O'Mullan C, Bugajim C and PH Brown** Exploring the design and adoption of a clean seed system for sweet potato in Papua New Guinea. *Journal of Crop Improvement,* 2022;**36(2):** 260-284.

17. **Mazuze FM** Analysis of Adoption and Production of Orange-Fleshed Sweet potatoes: The case study of Gaza Province in Mozambique. Master's Thesis. Michigan State University, Michigan, 2005.

18. **Integrated FC and D Plan** County Government of Homa Bay ' A County of Choice ' First County Integrated, 2017. https://www.knbs.or.ke/download/homa-bay-county/ *Accessed August 2021.*

19. National Population Census. https://www.knbs.or.ke/?wpdmpro=2019-kenya-population-and-housing-census-volume-i-population-by-county-and-sub-county, 2019, Kenya. *Accessed December 2020.*

20. **Kisumu County.** Kisumu County Integrated Development Plan II, of Kisumu County, 2018; 2018–2022.

21. **Okayo J, Odera P and S Omuterema** Socio-economic characteristics of the community that determines the ability to uptake precautionary measures to mitigate flood disaster in Kano Plains, Kisumu County, Kenya. Geoenvironmental Disasters, 2015;**2(1):** 26.

22. **Gido EO, Sibiko KW, Ayuya OI and JK Mwangi** Demand for agricultural extension services among small-scale maize farmers: Micro-level evidence from Kenya. *The Journal of Agricultural Education and Extension*, 2015;**21(2),** 177-192. https://doi.org/10.1080/1389224X.2013.872045

23. **Maake MMS and MA Antwi** Farmer's perceptions of effectiveness of public agricultural extension services in South Africa: an exploratory analysis of associated factors. *Agriculture & Food Security*, 2022;**11(1):** 1-15. https://doi.org/10.1186/s40066-022-00372-7

24. **Maruyama Y and T Sonoda** Theory of the producer-consumer household. Springer,2011.

25. **Tomlins K, Ndunguru G, Stambul K, Joshua N, Ngendello T, Rwiza E and A Westby** Sensory evaluation and consumer acceptability of pale-fleshed and orange-fleshed sweetpotato by school children and mothers with preschool children. *Journal of the Science of Food and Agriculture,* 2007;**87(13):** 2436-2446. https://doi.org/10.1002/jsfa.2931

26. **Shepherd AW** Approaches to linking producers to markets: A review of experiences to markets. Rome: Food and Agriculture Organization of the United States 2007.

27. **Leite CEC, Souza BDKF, Manfio CE, Wamser GH, Alves DP and A de Francisco** Sweet Potato New Varieties Screening Based on Morphology, Pulp Color, Proximal Composition, and Total Dietary Fiber Content via Factor Analysis and Principal Component Analysis. *Frontiers in Plant Science,* 2022;**13:** 852709-852709. https://doi.org/10.3389/fpls.2022.852709

28. **Eaton C and A Shepherd** Contract farming – partnerships for growth. Rome 2001.

29. **Ferris S, Robbins P, Best R, Seville D, Buxton A, Shriver J and E Wei** Linking smallholder farmers to markets and the implications for extension and advisory services. *MEAS Brief,* 2014;**4(10):** 13-14.

30. **Antwi-Agyei P and LC Stringer** Improving the effectiveness of agricultural extension services in supporting farmers to adapt to climate change: Insights from northeastern Ghana. *Climate Risk Management,* 2021;**32:** 100304. https://doi.org/10.1016/j.crm.2021.100304

31. **Ngailo S, Mtunda K, Shimelis HA and J Sibiya** Assessment of sweetpotato farming systems, production constraints and breeding priorities in eastern Tanzania. *South African Journal of Plant and Soil*, 2016;**33(2):** 105-112. https://doi.org/10.1080/02571862.2015.1079933

32. **Mudombi S** Adoption of agricultural innovations: The case of improved sweet potato in Wedza community of Zimbabwe. *African Journal of Science, Technology, Innovation and Development*, 2013;**5(6):** 459-467. https://hdl.handle.net/10520/EJC150312 *Accessed August 2021.*