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Research Article
(Araştırma Makalesi)

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Anahtar sözcükler: Tatlı patates üretimine yönelik kısıtlamalar, cinsiyet katılımı, katılım düzeyi, kök ve yumru bitkileri, tatlı patates çiftçileri

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Gender analysis of sweet potato production: the case of farmers in Delta State, Nigeria

Tatlı patates üretiminde cinsiyet analizi: Nijerya'nın Delta Eyaletindeki çiftçilerin durumu

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ABSTRACT

Objective: The main objective of this study is to examine the gender participation in sweet potato production (SPP) among farmers in Delta State.

Material and Methods: Multi-stage sampling procedure was used to select 131 respondents, comprising 73 male and 58 female sweet potato farmers. The data were obtained between October and December in 2019. Data were collected through interview schedule and analyzed using descriptive statistics, T-test, Pearson Product Moment Correlation and multiple regression.

Results: The results indicated that male and female farmers were at an age of 39.5±8.9 years old and 41.9±11.1 years old, respectively. Household sizes for male and female were 9±6 persons and 8±4 persons, respectively. Most male- (95.9%) and female- (81.0%) were formally educated. Men participated more in planting ($\bar{x}$=2.62), while women participated more in marketing ($\bar{x}$=2.91). The level of participation in SPP was high and low among more than half of the male- (56.2%) and female- (55.2%), respectively. Flooding was the highest constraint to SPP faced by male ($\bar{x}$=1.93) and female ($\bar{x}$=1.90).There was no significant difference between male and female level of participation in SPP (t=0.92;p>0.05), and constraints to SPP (t=0.74;p>0.05).Household size (β=-0.46); and education, household size and being married (r=0.26, 0.26, and β=4.19) significantly influenced male and female participation in SPP, respectively.

Conclusion: Household size influenced men participation in SPP while education, household size and marriage enhanced women participation in SPP.

ÖZ

Amaç: Bu çalışmanın temel amacı Delta Eyaletindeki çiftçiler arasında tatlı patates üretimine (TPU) cinsiyet katılımını incelemektir.

Materyal ve Yöntem: 73'ü erkek ve 58'i kadın tatlı patates çiftçisinden oluşan 131 katılımcıyı seçmek için çok aşamalı örnekleme metodu kullanıldı. Veriler 2019 yılı Ekim-Aralık ayları arasında elde edilmiştir. Veriler anket aracılığıyla toplanmış ve betimsel istatistikler, T-testi, Pearson Momentler Çarpımı Korelasyonu ve çoklu regresyon kullanılarak analiz edilmiştir.

Araştırma Bulguları: Sonuçlar, erkek ve kadın çiftçilerin sırasıyla 39, 5±8, 9 ve 41, 9±11, 1 yaşında olduklarını göstermiştir. Hane halkı büyüklüğü erkek ve kadınlarda sırasıyla 9±6 kişi ve 8±4 kişidir. Erkeklerin (%95, 9) ve kadınların (%81, 0) çoğu örgün eğitimlidir. Erkekler ekime daha fazla katılırken ($\bar{x}$=2, 62), kadınlar ise pazarlamaya daha fazla katılmıştır ($\bar{x}$=2, 91). TPÜ'ye katılım düzeyi sırasıyla erkeklerin (%56, 2) ve kadınların (%55, 2) yarısından fazlası arasında yüksek ve düşüktür. Su baskını, erkeklerin ($\bar{x}$=1, 93) ve kadınların ($\bar{x}$=1, 90) karşılaştığı TPÜ'ne yönelik en yüksek kısıtlamadır. Erkek ve kadınların TPÜ'ne katılım düzeyleri (t=0, 92;p>0, 05) ve GPP'ye yönelik kısıtlamalar (t=0, 74;p>0, 05) arasında anlamlı bir fark yoktur. Hane halkı büyüklüğü (β=-0, 46); ve eğitim, hane halkı büyüklüğü ve evli olmak (r=0, 26, 0, 26 ve β=4, 19) sırasıyla erkek ve kadınların TPÜ'ne katılımını anlamlı düzeyde etkilemiştir.

Sonuç: Hane halkı büyüklüğü erkeklerin TPÜ'ne katılımını etkilerken, eğitim, hane büyüklüğü ve evlilik kadınların TPÜ'ne katılımını artırmıştır.

INTRODUCTION

Sweet potato (SP) is one of the most significant crops and also one of the staple foods worldwide. It is the world's seventh most important food crop (Odebode et al., 2021) and fifth primary food crop on a fresh-weight basis (with respect to annual production) in developing countries (Oyibo, 2021). Common varieties include white-fleshed, red-fleshed, yellow-fleshed and orange-fleshed or reddish-purple. One percent of the world's agricultural land that is approximately nine million hectares is used to grow SP each year (Oyibo, 2021). It is the only major root and tuber crop whose leaves, shoots and tuberous roots are of tremendous use for both, humans and livestock.

Over the years, SP has become more important in the production of global food crops. According to Mwanja et al. (2017), it is widely grown throughout the tropical, subtropical and temperate regions of the world. In sub–Saharan Africa (SSA), Nigeria, Tanzania, Uganda, Ethiopia, Angola, Madagascar, Rwanda and Mozambique are the leading producers and consumers of SP (FAOSTAT, 2017). The countries accounts for 82.2 percent of the continent's total sweet potato production (SPP). Sweet potato is a staple and/or co-staple food crop throughout the aforementioned countries, especially in Nigeria, Uganda, Ethiopia, Kenya and Angola. According to Olagunju et al. (2013), Nigeria ranks number two in SPP in the world. Also, FAOSTAT (2017) named Nigeria as the top producer of SP in Africa and the only West African country among the top 20 SP-producing nations in the world.

In Nigeria, Delta State inclusive, SPP is a practical economic endeavor for income generation, food security and poverty reduction among rural households. In the country, SP has over several years been one of the major roots and tuber crops grown in Delta State and its production has always involved men and women. However, despite the seemingly bright employment and poverty reduction potentials of SPP in Nigeria and Delta State in particular, the crop, according to Odebode et al. (2021), is still under-explored. Oyibo & Odebode (2023) stated that little progress has been made in increasing the production level of SP in Nigeria, despite the several interventions by the Nigeria government as well as the nation having a wide variety of agro-climatic parameters that favor SPP. Also, despite the involvement of men and women in SPP, low production of SP is still prevalent in Delta State. This is because agricultural research and extension as well as interventions (policies, projects and programs) have not taken into account, the gender needs, differences and constraints.

Sweet potato production is influenced by gender as a result of the roles, responsibilities and constraints of the farmers (both men and women). According to Sangotegbe et al. (2013), gender issues may have a role in the poor rate of agricultural production. According to Olagunju et al. (2013), is because gender roles, relations and inequality affect agricultural production. Hence, for men and women to have a positive effect on their SPP and/or farming enterprise, agricultural research and extension would have to take into account gender roles, potentials and constraints. However, gender analysis of SPP that will give more information on the activity of women and men's potentials and constraints involved in SP farming enterprise as well as highlight the gender inequalities in SPP, has not been sufficiently investigated.

Women in SSA, including Nigeria, are more involved in agricultural activities, as well as provide most labor for a number of agricultural activities. Empirical data covering SSA villages has shown that generally, in farming households, more females and/or women did agricultural work than the male and/or men counterparts (Quisumbing et al., 2014). They are in the front position with respect to food production (Uzokwe et al., 2017), especially arable crops and staple food items. This is true to the extent that, generally speaking, women comprise around 90% of the workers engaged in the direct production of arable crops (Oyibo, 2021), which is difficult to ignore (Sangotegbe et al., 2013). Despite these contributions to food production by women, their interests, needs and priorities are not taken into consideration. They have not been given due recognition in the agricultural sector. This is because their specific activities and/or roles as well as problems encountered are poorly appraised as well as rarely articulated.

According to a study conducted by Sangotegbe et al. (2013), there is little to no scientific documentation on the specific activities and/or roles of female farmers in food production, including SPP. Although, Oyibo (2021) stated that women play a crucial role in the agricultural economies of all continents. However, the precise contribution's nature and magnitude are often challenging to determine and vary greatly between different nations and geographical areas of the world as well as across regions within countries (Sangotegbe et al., 2013). According to Sangotegbe et al. (2013), the specific activities and/or roles in agriculture, SPP inclusive, are not well-documented for women in Nigeria.

Despite the gender roles of farmers in agricultural production (including SPP), there are problems being faced by the farmers. Aboderin (2017) affirmed that despite the fact that women and men have different roles and access to resources, agricultural projects have not taken gender differences into account. Gender inequality remains a major problem that characterized the agriculture sector (Olagunju et al., 2013), SPP inclusive. Gender analysis has established that women have less control over decisions, incomes, choices and productive resources. They do not have equal access and control over resources, especially land and fund, as compared to men (Odebode et al., 2018), reducing their agricultural production. In addition, women/females face inequalities in accessing skill development, training opportunities and education, which impair their agricultural production. The foregoing persistent gender inequalities suggest that the gender dimension is crucial in the agricultural sector, including SPP sector, to prevent undermining a sustainable and inclusive development of the sector. However, gender-disaggregated data and/or scientific information to effectively plan SPP interventions (policies, projects and programs) have not been sufficiently provided. In lieu of the foregoing, the study was conducted with the following specific objectives: to describe the demographic traits of female and male SP producers; to determine the participation level of male and female farmers in SPP; and to identify the different SPP constraints based on gender. In light of the study's specific objectives, the following null forms-stated hypotheses were tested: there is no significant correlation between selected demographic traits and level of participation in SPP by gender; there is no significant correlation between constraints to SPP and level of participation in SPP by gender; participation in SPP by male and female farmers does not differ significantly; there is no significant difference in constraints to SPP between male and female; and selected independent variables do not significantly contribute to participation in SPP by gender.

MATERIALS and METHODS

Study area

The study was conducted in Delta State, which lies between longitudes 5°00' and 6°45' East of the Greenwich Meridian and latitudes 5°00' and 6°30' North of the equator. The State is divided into three agro ecological zones by the Delta State Agricultural Development Programs (DADPs). These are Delta South, Delta Central and Delta North zones.

Population and sampling procedure

All Delta State SP farmers made up the study's population. The respondents for the study were selected using a multi-stage sampling procedure. The first stage involved the purposive sampling of two (2) ADPs zones out of the three (3) in the study area based on predominance of SPP. Thus, Delta-Central and Delta-South were purposively selected. Delta-Central and Delta-South zones have 10 and six blocks respectively. The second stage involved stratification of the blocks in each of the selected zones into SP and non-SP producing blocks. The SP producing blocks were five and four in Delta-Central and Delta-South zones, respectively. The third stage involved random sampling of 40% of the SP producing blocks in the selected zones. The blocks sampled were Ughelli-South and Ughelli-North from Delta-

Central zone; Patani and Bomadi from Delta-South zone. The cells known for SPP in each of the selected block were identified. Altogether, 18 cells were identified in the selected blocks.

The fourth stage involved a random sampling of 25% of the SP producing cells in the selected blocks. These cells were Ewu from Ughelli-South block, Uwheru from Ughelli-North block, Bedeseigha from Patani block and Kpakiama from Bomadi block. The final stage, 20% of both male and female farmers responsible for SPP in the farming households were randomly selected from each of the selected cell from the list of SP farming households in the selected cells, for analysis, using proportionate sampling technique. The total number of male and female farmers responsible for SPP in the farming households randomly selected was 131. This comprised 73 males and 58 females.

Data collection

The data gathering took place between October and December 2019. Primary data was used for this study. Interview schedule was used to obtain the primary data. The interview schedule captured information on demographic characteristics, SPP's constraints, and extent (frequency) of participation in SPP.

Measurement of variables

Gender related constraints to SPP were measured at interval level. The respondents were presented with a list of 23 possible constraints which inhibit SPP. The severity of the 23 potential SPP constraints was measured. The response was rated on a three-point rating scale with the options "Severe constraint (2), " "Mild constraint (1), " and "Not a constraint (0)". A minimum score of 10 and a maximum score of 25.49 were obtained from the 23 constraint items.

Participation of males and females in SPP was also measured at interval level. A list of sixteen items generated from the literature on all SPP field and postharvest operations was provided. This was rated on a four-point rating scale of always, occasionally, rarely and not at all with scores of 3, 2, 1 and 0 assigned, respectively. The scores were summed for each respondent. The minimum and maximum scores obtained were 0 and 37.00, respectively. The mean (21.21±7.12) was used to categorize respondents into: low participation in SPP, scores between minimum and just below the mean (0.00–21.20), and high participation in SPP, scores between mean and maximum (21.21-37.00).

Data analysis

Data collected were entered into Statistical Package for Social Science (version 20), and analyzed using descriptive statistics (frequency counts, percentages, means and standard deviation) and inferential statistics (Chi-square, Pearson Product Moment Correlation-PPMC, spearman rho, independent samples t-test and multiple linear regression). Multiple linear regression was used to ascertain the significant contributors to participation in SPP field and postharvest operations. The multiple linear model used is expressed as in the following:

$$Y = a + b1X1 \ldots\ldots\ldots + bnXn + e \quad (1)$$

Where: Y = Participation in SPP field and postharvest operation scores (dependent variable); a = constant term or intercept; b_1, b_2……b_n = regression coefficients; X_1, X_2……..X_n = regression parameters; and e = Error term

The regression parameters that are included in the model are: X_1 = Age of respondents (actual age in years), X_2 = Marital status (married = 1, Otherwise=0), X_3 = Educational attainment of respondents (formal education=1, Otherwise=0), X_4 = Farming household size (actual number of persons in the household), X_5 = SP output.

RESULTS and DISCUSSION

Demographic characteristics of respondents

The results on age distribution of respondents indicate that the mean ages of the male and female farmers were 40 ± 9 years and 42 ± 11 years, respectively (Table 1). It could be deduced that most of the respondents were matured, in their economically active ages and possessing the wherewithal to actively participate in physical activities *vis a vis* SPP. The implication is that SP cultivation in the study area was carried out mostly by the middle-aged farmers who still have the enough potential to meet with the labor demands of SPP. This finding agrees with the findings in a study conducted by Ahmad et al. (2014). They found that farmers who were middle aged and in their active ages were involved in SPP in Kano State. On the other hand, this finding disagrees with finding of Olagunju et al. (2013) that the mean ages of the female and male SP farmers in Osun State were 54 years and 53 years, respectively. The educational attainment shows that 95.9% of male and 81.0% of female respondents had formal education. The study also shows that there were more males (76.4%) than females (47.9%) in the same educational groups with greater educational attainment who had both secondary and university education. This implies that male respondents' literacy level was higher than that of the female respondents. The implication is that male SP producers have a better chance as compared to their female counterparts as regards changes in their knowledge, skills and attitude, as well as enhance/increase utilization/adoption of novel methods, approaches and innovations in SPP *vis a vis* SPP intervention and evaluating information from several sources. This result contradicts Sugri et al. (2017) who found that over half of SP farmers in Northern Ghana had no formal education. The result, however, partly supports the finding of Aboderin (2017) that more male watermelon farmers than female counterparts had higher educational level, including both secondary and tertiary education, in Ibarapa area of Oyo State. In addition, the result is consistent with the findings of Oyibo (2020) that majority of rural farmers had formal education.

As regards the respondents' marital status, the majority of males (84.9%) and females (81.0%) were married whereas 2.7% of men and 19.0% of women had previously been married. This indicates that substantial proportion of the male and female farmers had family they were responsible for. The implication is that male and female farmers cultivating SP in the study area had family responsibilities (economic, resources and social responsibilities) that needed financial commitment. The results also suggest that male and female SP producers have the opportunity to receive assistance from their families (children and spouses) when it comes to performing SP field and postharvest operations. The result supports the finding of Oyibo (2021) that over 79.0% of SP farmers were married. The result is also consistent with Ofuoku & Aganagana (2018) finding that majority (75.0%) of rural farmers were married. The average household sizes of 9.0 ± 6.0 persons and 8.0 ± 4.0 persons were obtained for male and female farmers, respectively. It could be deduced that both male and female SP farmers had large households in the study area. The consequence of the big farming household size is that farmers' household would not struggle to offer a reasonable number of farm workers required for the farmers' SPP operations. This result partly agrees with Olagunju et al. (2013) who found that the average household sizes of female and male SP farmers were 7.0 persons and 7.0 persons, respectively. The results on yearly output of cultivated SP of respondents presented in Table 1 reveal disparity between male and female, SP farmers. While the mean SP output of male respondents in tones per annum was 83.6 ± 111.4, the mean SP output of female respondents was 57.2 ± 43.8 tones annum^{-1}. The SP farmers generally had low output of SP, with lower severity among male farmers than their female counterparts. The implication is that, irrespective of the gender of SP farmers in the research area, the SP farmers were generally small-scale farmers. The result is at variance with Olagunju et al. (2013) who found that the female SP farmers realized better SP output ($\bar{x}$=308.4 tones) than their male counterparts ($\bar{x}$=208.2 tones).

Table 1. Distribution of demographic characteristics of respondents

Çizelge 1. *Katılımcıların demografik özelliklerinin dağılımı*

Variables	Male		Female	
	Frequency	%	Frequency	%
Age (Years)				
≤ 20	0	0.0	0	0.0
21 – 30	11	15.1	14	24.1
31 – 40	35	47.9	15	25.9
41 – 50	18	24.7	17	29.3
51 – 60	8	11.0	9	15.5
> 60	1	1.4	3	5.2
	Mean ± SD = 39.5 ± 8.9		**Mean ± SD =** 41.9 ± 11.1	
Educational status				
No formal education	3	4.1	11	19.0
Primary education	14	19.2	25	43.1
Secondary education	34	46.6	20	34.5
NCE/OND	13	17.8	2	3.4
TC II	5	6.8	0	0.0
B. Sc./HND	3	4.1	0	0.0
Postgraduate	1	1.4	0	0.0
Marital status				
Single	9	12.3	0	0.0
Married	62	84.9	47	81.0
Divorced	2	2.7	0	0.0
Widowed	0	0.0	11	19.0
Household size (persons)				
1 – 5	26	35.6	21	36.2
6 – 10	31	42.5	28	48.3
>10	16	21.9	9	15.5
	Mean ± SD = 9.0 ± 6.0		**Mean ± SD =** 8.0 ± 4.0	
SP outputs (tones)				
1 – 10	1	1.4	3	5.2
11 – 20	11	15.1	9	15.5
> 20	61	83.5	46	79.3
	Mean ± SD = 83.6 ± 111.4		**Mean± SD =** 57.2 ± 43.8	

% = Percentage, SD = Standard deviation

Extent of participation in SPP

The majority of male farmers, as tabulated in Table 2, agreed that they always participated in more time-and-energy-consuming field and postharvest activities of SPP than the minority of female farmers who responded to similar categories. These operations include sorting [54.8% (male), 48.3% (female)], weeding [41.1% (male), 19.0% (female)], pest and disease control [42.5% (male), 20.7% (female)], storage [49.3% (male), 34.5% (female)], irrigation [43.8% (male), 36.2% (female)], and land clearing [17.8% (male), 5.2% (female)]. The result is in agreement with the findings obtained by Olagunju et al. (2013) and Aboajah et al. (2018) that land clearing and/or land preparation was done mostly by male SP farmers. The findings also agree with Odebode et al. (2018) who found that men performed tedious operations like weeding. However, the results contradict the findings of Olagunju et al. (2013) and Aboajah et al. (2018) that weeding was carried out mostly by female SP farmers. The Table further revealed the field and postharvest operations majority of female always participated in, in contrast to the minority of male farmers who consistently performed the same operations. These field and postharvest operations included marketing [93.1% (female), 37.0% (male)], planting [77.6% (female), 72.6% (male)] and packing/picking of tubers [34.5% (female), 30.1% (male)]. The high participation in marketing activity implies that SPs are disposed by

females. The result supports the finding of Olagunju et al. (2013) that marketing and planting were done mostly by female SP farmers. Aboajah et al. (2018) also found that female SP farmers account for planting operation. However, some of the field and postharvest operations were always participated in by female and male at a close range of proportion. They included harvesting [43.1% (female), 41.1% (male)], packing of cleared vegetation [36.2% (female), 32.8% (male)], and transportation/carriage [17.2% (female), 16.4% (male)]. The result disagrees with the finding of Olagunju et al. (2013) and Aboajah et al. (2018) that harvesting was done mostly by female SP farmers, while land preparation/packing of cleared vegetation was carried out mostly by male SP farmers. This result, however, agrees with the findings of Odebode et al. (2018) that both female and male were involved in harvesting activity.

The difference in the degree of participation of males and females in the various field and postharvest activities in SPP is indicated by the mean distribution. The top five operations performed/participated by men, as shown in Table 2, were planting (2.62), weed control (2.02), harvesting (1.96), sorting (1.90) and irrigation (1.90). The top five activities participated/performed by female farmers were marketing (2.91), planting (2.66), harvesting (1.98), sorting (1.93), and irrigation (1.72). The result disagrees with Aboajah et al. (2018) who reported land preparation and ridging as the top operations involved by male SP farmers. The result, however, agrees with Aboajah et al. (2018) who reported planting and harvesting as the top operations involved by female SP farmers. Additionally, Table 2 shows that there is a higher degree of participation in the tiresome and/or time-consuming field and postharvest activities of land clearing, weed control, pest and disease control, irrigation, and storage with the respective means of 1.16 (male) and 0.75 (female) for land clearing; 2.02 (male) and 1.00 (female) for weed control; 1.84 (male) and 1.03 (female) for pest and disease control; 1.90 (male) and 1.72 (female) for irrigation; and 1.81 (males) and 1.45 (female) for storage.

Table 2. Distribution of participation in field and postharvest activities of SPP

Çizelge 2. *TPÜ'in tarla ve hasat sonrası faaliyetlerine katılım dağılımı*

Operation/Activities	Male					Female				
	A %	O %	R %	N %	Mean	A %	O %	R %	N %	Mean
Land clearing	17.8	26.0	11.0	45.2	1.2	5.2	25.9	10.3	88.6	0.8
Packing of cleared vegetation	32.8	17.8	16.4	32.9	1.5	36.2	19.0	10.3	34.5	1.6
Burning	17.8	0.0	1.4	80.8	0.6	12.1	3.4	1.7	82.8	0.5
Ridge/heap making	1.4	4.1	2.7	91.8	0.2	5.2	1.7	1.7	91.4	0.2
Planting	72.6	19.2	5.5	2.7	2.6	77.6	13.8	5.2	3.4	2.7
Mulching	1.4	5.5	0.0	93.2	0.2	1.7	6.9	0.0	91.4	0.2
Irrigation	43.8	24.7	9.6	21.9	1.9	36.2	25.9	12.1	25.9	1.7
Fertilizer application	4.1	4.1	2.7	89.0	0.2	8.6	5.2	1.7	84.5	0.4
Weed control	41.1	37.0	5.5	16.4	2.0	19.0	17.2	8.6	55.2	1.0
Pest and disease control	42.5	23.3	9.6	24.7	1.8	20.7	15.5	10.3	53.4	1.0
Harvesting	41.1	30.1	12.3	16.4	2.0	43.1	31.0	6.9	19.0	2.0
Packing/Picking of tuber	30.1	21.9	16.4	31.5	1.5	34.5	22.4	12.1	31.0	1.6
Sorting	54.8	8.2	9.6	27.4	1.9	48.3	19.0	10.3	22.4	1.9
Transportation/carriage	16.4	12.3	8.2	63.0	0.8	17.2	6.9	5.2	70.7	0.7
Storage	49.3	9.6	13.7	27.4	1.8	34.5	17.2	6.9	41.4	1.5
Marketing	37.0	16.4	15.1	31.5	1.6	93.1	5.2	1.7	0.0	2.9

A = Always; O = Occasionally; R = Rarely; N = Never, % = Percentage

Categorization of participation in SPP

Table 3 reveals the results of participation in all the SPP field and postharvest operations by male and female respondents. More than half of the male respondents (53.4%) highly participated in SPP field and postharvest operations. Conversely, 58.6% of the female respondents had low participation in SPP

field and postharvest operations. This implies that there was a higher participation of male farmers in SPP field and postharvest operations than the female farmers, which is suggestive that the male farmers channeled higher energy into their SP farming business than their female counterparts.

Table 3. Categorization of respondents' according to participation in field and postharvest activities of SPP

Çizelge 3. *Katılımcıların TPÜ'in tarla ve hasat sonrası faaliyetlerine katılımlarına göre sınıflandırılması*

Participation	Male		Female	
	Frequency	Percentage	Frequency	Percentage
Low	34	46.6	34	58.6
High	39	53.4	24	41.4

Constraints to SPP

Table 4 shows the various constraints faced by male and female SP farmers in the study area. The Table reveals that on the overall, most of the male respondents indicated flooding ($\bar{x}$=1.9) as SPP's biggest constraint. This was followed by inadequate capital ($\bar{x}$=1.8), limited knowledge of SP processing ($\bar{x}$=1.8), inadequate credit facilities ($\bar{x}$=1.7), and difficulties associated with transportation in tropical condition ($\bar{x}$=1.6). With respect to the female respondents, it was indicated that flooding ($\bar{x}$=1.9) was the SPP's highest constraint. This was followed by limited knowledge of SP processing ($\bar{x}$=1.9), difficulties associated with transportation in tropical condition ($\bar{x}$=1.9), inadequate capital ($\bar{x}$=1.8), and inadequate credit facilities ($\bar{x}$=1.7).

Table 4. Constraints to SPP

Çizelge 4. *TPÜ'ne yönelik kısıtlamalar*

Constraints to SPP	Male				Female			
	SC %	MC %	NC %	Mean	SC %	MC %	NC %	Mean
Poor extension services	69.9	8.2	21.9	1.5	81.0	1.7	17.2	1.6
Few markets for SP	63.0	23.3	13.7	1.5	58.6	27.6	13.8	1.5
Limited knowledge on processing of SP	79.5	17.8	2.7	1.8	86.2	13.8	0.0	1.7
Poor storability of SP	57.5	19.2	23.3	1.3	63.8	13.8	22.4	1.4
Difficulties associated with transportation in tropical condition	76.7	11.0	12.3	1.6	87.9	8.6	3.4	1.9
Scarcity/inadequacy of land for SPP	46.6	21.9	31.5	1.2	43.1	27.6	29.3	1.1
Inadequate capital	83.6	15.1	1.4	1.8	79.3	17.2	3.4	1.8
Inadequate credit facilities	72.6	24.7	2.7	1.7	74.1	20.7	5.2	1.7
Sweet potato pests (field/store)	61.6	35.6	2.7	1.6	56.9	37.9	5.2	1.5
High susceptibility to disease	37.0	41.1	21.9	1.1	39.7	39.7	20.7	1.2
Lack of improved cultivars	46.6	23.3	30.1	1.1	44.8	24.1	31.0	1.1
Low yield of SP	31.5	42.5	26.0	1.1	24.1	43.1	32.8	0.9
Inadequacy/shortage of seedling at planting time	50.7	26.0	23.3	1.3	34.5	37.9	27.6	1.1
Low cash value per unit of weight	64.4	26.0	9.6	1.6	60.3	32.8	6.9	1.5
Sweet potato is being overlooked by consumer	26.0	41.1	32.9	0.9	34.5	24.1	41.4	0.9
Drought	64.4	15.1	20.5	1.4	46.6	36.2	17.2	1.3
Flooding	94.5	4.1	1.4	1.9	91.4	6.9	1.7	1.9
Shortage of herbicide	1.4	0.0	98.6	0.0	0.0	0.0	100.0	0.0
Lack of tractors	0.0	0.0	100.0	0.0	0.0	0.0	100.0	0.0
Farmers/Herdsmen conflict	64.4	0.0	35.6	1.3	41.4	0.0	58.6	0.8
Inadequacy of laborers	0.0	0.0	100.0	0.0	0.0	0.0	100.0	0.0
Insufficient fertilizer	0.0	0.0	100.0	0.0	0.0	0.0	100.0	0.0
Lack of irrigation facilities	0.0	0.0	100.0	0.0	0.0	0.0	100.0	0.0

SC = Serious Constraint; MC = Mild Constraint; NC = Not a Constraint, % = Percentage

It could be deduced that flooding, inadequate capital, limited knowledge of SP processing, inadequate credit facilities, and difficulties associated with transportation in tropical condition were major challenges to SPP in Delta State. However, unlike the male farmers that indicated that flooding, inadequate capital, limited knowledge of SP processing, inadequate credit facilities, and difficulties associated with transportation in tropical condition were first, second, third, fourth and fifth most severe constraints, the female group posited that flooding, inadequate capital, limited knowledge of SP processing, inadequate credit facilities, and difficulties associated with transportation in tropical condition were first, fourth, second, fifth, and third most severe constraints.

These findings are in line with a similar study by Aboderin (2017) who reported inadequate credit facilities, poor transportation system, and lack of processing technology, as major constraints to male and female farmers carrying out watermelon production. However, lack of credit, poor transportation system, and lack of processing technology were identified as the first, sixth and fifth factors that hindered male farmers watermelon production, while for female farmers, the foregoing factors ranked first, seventh, and fifth. Sangotegbe et al. (2013) reported inadequate funding and bad weather effect as major challenges to rice production among male and female farmers in Obafemi Owode Local Government Area of Ogun State, Nigeria; inadequate funding and bad weather effect ranked first and sixth for male farmers in contrast to second and third for female farmers. Additionally, lack of knowledge on production and processing of SP, inadequate technological skill/know-how on local processing, inadequate access to credit facilities, poor access to credit and inadequate finance were identified by Sugri et al. (2017) as the major challenges to SPP.

Relationship between selected demographic characteristics and level of participation in SPP by gender

The results in Table 5 indicate that male respondents household size (r = -0.3) was significantly ($p < 0.05$) related to participation in SPP field and postharvest activities, while female respondents' level of education (r = 0.3) and household size (r = 0.3) were significantly ($p < 0.05$) related to participation in SPP field and postharvest activities. This implies that household size and level of formal education of respondents had significant relationship with participation status in SPP field and postharvest activities.

Table 5. Relationship between selected demographic characteristics and level of participation in sweet potato production by gender

Çizelge 5. *Seçilmiş demografik özellikler ile tatlı patates üretimine katılım düzeyi arasındaki cinsiyete göre ilişki*

Variables	Male				Female			
	Df	χ^2	r-value	p-value	Df	χ^2	r-value	p-value
Age	-	-	-0.2	0.06	-	-	0.0	0.92
Education level	-	-	-0.1	0.27	-	-	0.3*	0.05
Marital status	2	0.7	-	0.70	1	1.1	-	0.29
Household size	-	-	-0.3*	0.02	-	-	0.3*	0.05
Output of SP	-	-	-0.1	0.28	-	-	0.0	0.90

df = Degree of Freedom, **χ^2 =** Chi-square Coefficient, r = Correlation coefficient, *Significant at $p \leq 0.05$.

The positive correlation between household size of female respondents and participation status in SPP field and postharvest operations implies that female farmers' participation in SPP field and postharvest operations increases as the size of their households' increases. Increased household size implies increase in quantity and/or number of family labor available for use as labor source, thereby increases support from families (husbands and children) as far as carrying out of SP field and postharvest operation is concerned which could translate into female farmers more commitment in SPP and high participation in SPP field and postharvest operations. The positive correlation between level of formal education and participation status in SPP field and postharvest operations implies that formal education of the female respondents influences their participation status in SPP field and postharvest operations.

Hence, high level of education will likely enhance high participation in SPP field and postharvest operations. Formal education attainment enables female respondents to apply their education to critically observe, analyze and take advantage of SP wide range of desirable attributes to make the best out of their less or low access and control over assets (especially land and fund), thereby, resulting in increased participation status in SPP field and postharvest operations.

The negative correlation between male respondent's household size and participation level in SPP field and postharvest operations indicates that the bigger the farming household of male farmers, the less his participation in SPP field and postharvest operations. The bigger the farming household, the more and/or higher the family responsibility placed upon the male farmers as well as number of family members available as farm labor. This can lead to increased economic, resources and social obligations that needs financial commitment as well as increased supports from families (wives and children) as far as carrying out of SP field and postharvest operation is concerned which could translate into male farmers diversification into other activities *vis a vis* livelihood activities and low participation in SPP field and postharvest operations.

Relationship between constraints to SPP and level of participation in SPP by gender

Table 6 indicates that no significant ($p > 0.05$) correlation existed between constraints to SPP and participation in SPP field and postharvest operations for the male ($r = 0.1$) and female ($r = -0.2$) farmers. It implies that male and female respondents' constraints to SPP had no significant relationship with their participation status in SPP field and postharvest operations. It could be deduced that the constraints to SPP of the male and female respondents do not necessarily affect and/or determine their participation level in SPP field and postharvest operations. The fact that male and female respondents have high constraints to SPP does not guarantee low participation in SPP field and postharvest operations. Male farmers' participation status in SPP field and postharvest operations is influenced by household size, while female farmers are enhanced by both household size and level of formal education.

Table 6. Relationship between constraints to SPP and level of participation in SPP by gender

Çizelge 6. *Cinsiyete göre TPÜ kısıtlamaları ile tatlı patates üretimine katılım düzeyi arasındaki ilişki*

Variable	Male		Female	
	r-value	p-value	r-value	p-value
Constraints to SPP	0.1	0.38	-0.2	0.13

r = Correlation coefficient.

Gender difference in level of participation SPP

Table 7 shows no significant ($p > 0.05$) difference in participation in SPP field and postharvest operations of male and female farmers ($t = 0.9$). However, male SP producers (21.7 ± 7.4) had higher participation status in SPP field and postharvest operations than female (20.6 ± 6.8), with a mean difference of 1.2. The no significant difference in participation in SPP field and postharvest operations of male and female farmers implies that participation in SPP field and postharvest operations does not differ between the male and female farmers. The implication is that, notwithstanding a few minor differences between the roles played by male and female SP producers in field and postharvest operations of SPP, on the overall, the role performed by male in SPP does not differ from the role by female. Hence, both females and males are important actors in the production of SP. This finding corroborates Sangotegbe et al. (2013) that the involvement level in Ofada rice production does not differ significantly based on gender. However, this finding is in contradiction with the results obtained by Aboderin (2017). He found that gender differences existed significantly in roles performed in watermelon production.

Table 7. Difference between the level of participation of male and female farmers in SPP

Çizelge 7. *Erkek ve kadın çiftçilerin TPÜ'ne katılım düzeyleri arasındaki fark*

Variable	No. of case	Mean	SD	Mean difference	t-value	Df	p-value
Male	73	21.7	7.4	1.2	0.9	129	0.35
Female	58	20.6	6.8				

Gender difference in constraints to SPP

Table 8 reveals no significant difference between constraints to SPP of male (25.8 ± 5.3) and female (25.1 ± 5.4) producers of SP ($t = 0.7$, $p > 0.05$). The null hypothesis is therefore accepted. This implies that male and female farmers face almost the same constraints to SPP. Hence, it could be deduced that the constraints to SPP affect and/or hinder both male and female farmers almost at the same level. The implication is that the constraints encountered by male and female grouping are felt in almost the same way by the respondents in the different categories. An earlier study by Aboderin (2017) found that male and female watermelon farmers had similar constraints in watermelon production.

Table 8. Difference in constraints to SPP between male and female farmers

Çizelge 8. *Erkek ve kadın çiftçiler arasındaki TPÜ kısıtlamalarındaki fark*

Variable	No. of case	Mean	SD	Mean difference	t-value	Df	p-value
Male	73	25.8	5.3	0.7	0.7	129	0.46
Female	58	25.1	5.4				

Contribution of selected independent variables to participation in production of SP by gender

Table 9 reveals that, for male and female respondents, the R^2 values were 0.17 and 0.21, respectively. This indicates that the selected independent variables explained for 17.0% and 21.0% of participation status in SPP field and postharvest operations of respondents in the respective gender categories. In male respondents' category, household size ($\beta = -0.5$, $p < 0.10$), while in female respondents, (married) marital status ($\beta = 4.2$, $p < 0.10$) contributed significantly to participation status in SPP field and postharvest operations.

Table 9. *Regression analysis on contribution of selected independent variables to participation status in SPP by gender*

Çizelge 9. *Seçilen bağımsız değişkenlerin tatlı patates üretimine katılım durumuna cinsiyete göre katkısı üzerine regresyon analizi*

Variables	Male			Female		
	β- value	t- value	p- value	β- value	t- value	p- value
Age	-0.0	-0.0	0.98	0.0	0.3	0.79
Marital status (Married)	-2.5	-0.9	0.36	4.2**	1.8	0.09
Educational attainment	1.9	0.4	0.67	3.0	1.2	0.25
Household size	-0.5**	-1.9	0.06	0.4	1.5	0.13
SP output	0.0	0.0	0.97	-0.0	-0.1	0.92
Constraints	0.3	1.5	0.15	-0.2	-0.9	0.39
Summary						
R-value	0.4			0.5		
R^2	0.17			0.21		
Adjusted R Square	0.1			0.1		
Standard Error of the estimated	7.2			6.5		

**Significant at p≤0.10.

This implies that household size and marital status were major contributors to respondents' participation status in SPP field and postharvest operations. The household size of male respondents and marital status of female respondents were contributors to participation in SPP. The significant and negative contribution of household size of male respondents implies that increased household size led to low participation in SPP field and postharvest operations. The implication is that with increased household size, male respondents are likely to decrease participation in SPP. The significance of marital status of female respondents implies that it contributed significantly to increasing participation status in SPP field and postharvest operations as being married appeared to have a positive effect on their participation in SPP. Hence, individuals who are married will enhance high participation in SPP.

CONCLUSION

Sweet potato farmers were matured and middle aged with family responsibilities that needed financial commitment. They would not have any trouble finding enough family labor for SPP operations. Although, both male and female farmers are formally educated, male farmers' literacy level was high compared to female respondents. The male and female farmers generally had low output of SP, with lower severity among male farmers.

The most important constraints to SPP as noted by male and female farmers were flooding and inadequate capital; and flooding, and limited knowledge of SP processing, respectively. Planting, weed control, and harvesting were the top three SPP field and postharvest operations participated in by male, while for female marketing, planting and harvesting were the top three operations in which they participated. Male farmers always engaged in tiresome and/or time-consuming field and postharvest activities of SP production such as sorting, weeding, pest and disease control, storage, irrigation, and land clearing while female always participated in less tedious field and postharvest operations such as marketing, planting and packing/picking of tuber.

Finally, the male and female farmers face almost the same constraints to SPP, implying that the constraints encountered by male and female grouping are felt in almost the same way by the respondents in the different categories. Although there were minimal differences between the roles played by men and women SP producers in field and postharvest operations of SPP, on the overall, the participation by male in SPP does not differ from the participation by female. Increased household size influenced male and female farmers' participation in production of SP, while education enhanced female farmers' participation in production of SP. Constraints to SPP of the male and female respondents do not necessarily affect and/or determine their participation level in SPP field and postharvest operations. Household size of male respondents and marital status of female respondents were contributors to participation in SPP, however, increased household size of male respondents led to low participation in SPP field and postharvest operations while being married had a positive effect on female respondents' participation in SPP.

Based on the conclusion, the following recommendations can be implemented:

1. Female should be rigorously targeted during intervention programs especially on capacity building due to their lower level of education. In addition, female farmers should be encouraged to regularly participate in SP farming related training as this would enhance their ability to deal with the dynamic nature of constraints to SPP.
2. The result of this study showed that female farmers who are married and with large household size are mainly high in Delta State of Nigeria, and that increased or large household size and being married enhanced female farmers participation in SPP, it is recommended that intervention programs should embrace and offer sensitization on benefits of large household size and being married to its female beneficiaries during the official span of the program. Married female farmers with large household size should be rigorously targeted during intervention programs for sweet potato farming households.

3. Intervention programs and/or projects should place emphasis on ensuring that SP postharvest handing (storage and processing) knowledge and/or technologies are provided to male and female farmers. Agricultural extension agents should incorporate SP postharvest handing (storage and processing) in extension packages and improve on transmission of SP postharvest handing (storage and processing) information to male and female farmers.

4. Extension agencies (especially the Agricultural Development Programs, and Root and Tuber Expansion Programme) and research institutes (especially the National Root Crops Research Institute) should work and cooperate more closely together in terms of campaign and provision of information on improved SPP with great consideration for gender implication. In addition, research institutes and extension services must concentrate on finding solutions to the problems that both male and female farmers face.

Data Availability

Data will be made available upon reasonable request.

Author Contributions

Conception and design of the study: OO, SOO; sample collection: OO; analysis and interpretation of data: OO, SOO; statistical analysis: OO; visualization: OO, SOO; writing manuscript: OO.

Conflict of Interest

There is no conflict of interest between the authors in this study.

Ethical Statement

This study was conducted with the approval from the Local Social and Behavioral Science Ethics Committee of the Department of Agricultural Extension and Rural Development, University of Ibadan, Nigeria on the 24/04/2019 (number: AERD/04-2019/0012).

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