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Effect of Adoption on Yield of Improved Ginger Production Technologies in South-East, Nigeria: A Gender Situation Analyses

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Abstract
The study analyzed effect of adoption on yield of improved ginger production technologies by gender in South-East Nigeria. A Multi-stage and proportionate sampling techniques were used to select 250 ginger farmers (125 males and females each). Data were collected with a questionnaire and analyzed using descriptive (such as means, percentages, 3 point rating scale), and inferential (Z-test) statistics. The result shows that majority (81.60%) of the male and female (89.60%) farmers were married, with mean farm sizes of 1.30ha and 0.69ha respectively. The result also shows that the mean annual farm income was ₦971436.656 (male) and ₦513012.8 (female), whereas the average quantity of ginger produced per annum was 13.853t and 7.598t in that order. Average yield of ginger produced per hectare was 10.958t/ha for male and 10.327t/ha for female, implying that the male farmers had slightly higher yields than their female counterparts. This could be because men adopted the improved ginger production technologies more than their female counterparts. Results further showed that awareness and adoption levels were higher among the male farmers than their female counterparts as 16 out of 22 innovations disseminated to the ginger farmers were highly adopted by the male respondents, whereas only 14 were adopted by the females. Furthermore, the results showed that the male farmers had greater access to (2.568) and greater control (2.464) over production resources than their females (0.992) access to (1.816) and control over same resources. However, both male (2.736) and female (2.608) farmers were fully involved in decision making in ginger production on a 3-point graphic rating scale. The Z-test result of significance difference in ginger yield between male and female farmers showed evidence of significant differences in ginger yields, with a Z-value of 1.8268 which was positive and significant at 10% level. This shows that gender had a significant effect on ginger yield in South-East Nigeria, implying that the male ginger farmers performed better than their female counterparts. The study therefore recommends, among others, that government should reduce the gender gap in access to, and control over production resources in the region.

Keywords: Adoption, Gender, Access, Production Resources, Ginger farmers

Introduction

Producing almost 523,000 metric tonnes annually, Nigeria is the leading producer of ginger in Africa and the second largest producer in the world after India with a 14% share in total global production and is projected to keep growing at 6% per annum (FAOSTAT, 2017 and Nigerian Export Promotions Council, 2018). About 90% of Nigerian ginger production is exported which makes Nigeria the third highest exporter of the crop globally (NEPC, 2018). Experts say that Nigerian ginger stands out because of its pungency and high level of oleoresin oil; the active ingredient most people look for in ginger. However, despite the potential in the production of the crop, the country is yet to fully harness the economic benefits from growing ginger, on account of low quality seeds and low use of technology. In Nigeria, the average yield on a hectare of farmland is about 13-27mt in comparison to the global average of about 35-40 metric tonnes (ThriveAgric, 2020).

Ginger has been grown in Nigeria since about 1927, and mainly in the Northern part of Nigeria, i.e. Kaduna, Nasarawa, Benue, Niger and Gombe as major producing States. However, since it is a tropical crop that requires high amount of rainfall, and can also grow in the southern States. According to Amadi, Ewuziem, Njoku, Nwaogu, Danbaba, and Ebeniro, (2013), the National Root Crops Research Institute (NRCRI) pioneered ginger cultivation research in the South. The institute has mandate into the genetic improvement, production, processing, storage, utilization and marketing of root and tuber crops of economic importance in Nigeria

(Ibeneme, 2021). The mandate crops are cassava, yam, sweet potato, cocoyam, ginger, potato, sugar beet, turmeric, rizga and Hausa potato, and carries out the research work sometimes in collaboration with other research centers like the International Institute for Tropical Agriculture (IITA), faculties of agriculture of universities in the country etc. These research efforts have led to the development of many improved technologies (Mbanaso, Agwu, Anyanwu and Asumugha, 2012). For ginger, these technologies include; site selection, land preparation, timely planting, use of grass mulch, use of broad leaves mulch, appropriate spacing, use of organic manure, use of in-organic manure, use of herbicide, improved ginger varieties, notable among which are the UG1 and UG2. This result has not only completely erased the belief that good ginger finger cannot be obtained from the Southern parts of the country but has proved that high yield per hectare is equally obtainable. Ejechi Tologbonse, Adeniji and Ono (2013) reported that better yields are obtained when improved crop genotypes are used with suitable cultural practices.

Studies have shown that technology adoption has a direct effect on the farmer's income, usually resulting from higher yields, higher prices, or both. Yield improving technologies usually involve bundling of improved seeds with appropriate fertilizer, pesticides, fungicide applications, etc. According to Karanja, Renkow and Crawford (2003), if farmers fail to adopt the package, higher outputs may not be realized. Studies have shown positive correlation between adoption of extension recommendations by farmers and crop yields which translate into increased income and improved quality of life of farmers (Ejechi *et al.*, 2013). However, the most important determinant of the effectiveness of research results is the level of adoption of innovations that it generates, and on their profitability (Okoye, Nwankwo, Eluwa and Madu, 2012). The adoption of improved production practices by farmers leads to improved yields of crops. Agbarevo (2010), noted increase in farmers' output as a result of application of better technologies can be used to measure the success of an agricultural development programme, or project because increase in production translates into increased income, which further translates into improved standard of living. Therefore, based on the aforementioned, this paper seeks to analyze ginger yield by male and female ginger farmers in South-East, Nigeria in order to ascertain the effect of adoption of the improved ginger production technologies on yield in the region.

Hypothesis

H_0: There is no significant difference in ginger yield between male and female ginger farmers.

Methodology

This study was conducted in South-East Geo-Political Zone of Nigeria; made up of five states viz: Abia, Anambra, Ebonyi, Enugu and Imo. Multistage and proportionate sampling techniques were used in the selection of the location and respondents. The first stage involved a purposive selection of three out of the five states in the South-East Geo-Political zone namely: Abia, Imo and Anambra. The selection was due to high concentration and intensity of ginger production by men and women in this area. For the second stage, the sampling frame of registered ginger farmers were collected from the various ginger growers association presidents in the selected states. Due to an unequal distribution of registered farmers in the selected states, proportionate sampling technique was used to select the sample population; 20% was allotted to Anambra, and 40% to Abia and Imo each. In the last stage, each ginger farmer was given a serial identifier and then an appropriate number of the population was randomly chosen. Fifty (50) ginger farmers (25 male and female each) were randomly selected from Anambra, while 100 farmers (50 male and female each) were also randomly chosen from Abia and Imo, giving an aggregate of 250 respondents which constitutes the sample population for the study. Using structured questionnaire, data relevant to the study were collected from the respondents and analyzed using both descriptive (such as frequency, percentage, mean) and inferential (Z-test) statistics.

Model Specification

Descriptive statistic tools such as frequencies, means, percentages and tables were employed to ascertain the level of awareness of ginger production technologies disseminated to the ginger farmers in the study area; whereas, the level of adoption of improved ginger production technologies by farmers was determined using a 3- point graphic rating scale designed to measure farmers' adoption level following Agbarevo (2015). The mean responses were computed and used as the adoption index. The response categories and the corresponding weighted values are as follows: Never adopted = 1, Adopted and stopped = 2, Adopted and still using innovation =3. Total adoption score for each farmer was calculated by adding up the adoption scores for the various technologies. Farmers with adoption score of 2.0 and above were regarded as having reached average score of technology. The scale was modified thus: a mean >2.5=high adoption level, 2 − 2.5= moderate adoption level, and < 2.00 =very poor adoption level.

The level of access to production, control over production resources and involvement in decision making by male and female farmers in ginger production, was ascertained using a 3-point type rating scale. This was achieved using mean count. The response options and corresponding weighted assigned values are as follows: No access = 1, Limited access = 2, Full access =3, and gender disaggregated. Respondents with mean score of 2.0 and above implied that they had full access/full involvement, while respondents with mean score of less than 2.0 implied limited access/involvement. To determine the mean Likert level, Xs of each item was computed by multiplying the frequency of each response pattern with its appropriate nominal value and dividing the sum with number of respondent to the items. This can be summarized in the

equation thus:

$Xs = \sum fn/N$ ....(1)

Where; Xs = mean score, $\sum$ = summation, f = frequency, n = Likert nominal value, N = Number of the respondents

$$Xs = \frac{1+2+3}{3} = \frac{6}{3} = 2 \ldots . (2)$$

Z- test was used to test the hypothesis of significant difference in ginger yield between male and female farmers. This hypothesis was tested using Z-test at 10% level of significance as specified. The choice of Z-test to test the hypothesis is because n >30.

$$Z_{cal} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\delta^2 \bar{X}_1}{n_1} + \frac{\delta^2 \bar{X}_2}{n_2}}} \quad \ldots . (3)$$

Where; Z = calculated value, $\bar{X}_1$ = Mean ginger yield of males, $\bar{X}_2$ = Mean ginger yield of females. $\delta^2 X_1$ = Sample variance of yield for males, $\delta^2 X_2$ = Sample variance of yield for females, n_1 = Sample size of males, n_2 = Sample size of females

Decision: if $Z_{cal} > Z_{tab}$ at ($P \leq 0.10$) we reject the null hypothesis

Results and Discussion

Socio-economic Characteristics of the Respondents

The findings in Table 1 show that majority (81.60%) of the male and female (89.60%) ginger farmers in South-East Nigeria were married. This implies that ginger production is dominated by farmers who are married, which could increase their access to production inputs like land which are traditionally owned by men. The result also shows that large percentage (72.8%) of the male and (96%) female respondents had farm sizes ranging between 0.1-1.0 hectares each, with mean farm sizes of 1.30ha for the male and 0.69ha for the female. This implies that all the respondents had small farm holdings. They grow ginger on a small scale, and the likely implication of this is small output. Ibeneme (2016) indicated that farm size is one of the parameters for determining the scale of operation of producers. From the finding, the size of the farms varies across gender in the study area. The average annual income was ₦971,436.66 for male and ₦513,012.80 for female. The high income observed by the males may be as a result of larger farm sizes cultivated by male compared to the female. This conforms to the report of Nto, Ekeagwu, and Azubuike (2013) who noted that variation in income may be gender sensitive because the productivity rate of males in farm work is higher than that of the females because farm work needs strength and energy.

Further result shows that the average quantity of ginger produced per annum by the farmers was 13.853t for male and 7.598t for female. This shows that the male farmers produced more quantity of ginger than their female counterparts, which may be because male ginger farmers had larger farm sizes than the female farmers. Generally, an average of 10.725t of ginger is produced by the farmers annually. The average yield of ginger produced per hectare is 10.958t/ha for male and 10.327t/ha for female ginger farmers. This implies that the male farmers had slightly higher yields than the females. This could be because men had larger farm sizes and they adopted the improved ginger production technologies more than the females.

Awareness and Adoption Level of Ginger Production Technologies Disseminated to Farmers in South-East Nigeria

The results in Table 2 show the awareness and adoption level of ginger production technologies disseminated to the ginger farmers in South-East Nigeria. Descriptive statistics were used to ascertain the awareness level, while a 3-point graphic rating scale was used to determine the adoption levels of male and female ginger farmers. The ginger production technologies disseminated to ginger farmers by NRCRI were listed for farmers to identify and ascertain their levels of awareness. Out of the 22 technologies listed, majority of the male and female ginger farmers indicated awareness of all the technologies at different levels, although awareness level was higher for the male farmers with a mean of 86.65% compared to their female counterparts with a mean of 83.9%. However, the "2nd mulching at maturity and crop left un-harvested as storage method" and "the use of cow dung + NPK 20:10:10 fertilizer" technologies had low awareness levels by both male and female ginger farmers. This implies that awareness level of the disseminated technologies was generally high but higher for the male ginger farmers than their female counterparts. The result shows that majority of the technologies disseminated to the ginger farmers were adopted at different levels by both male and female ginger farmers but higher among the males. The result further showed that only three (3) out of the 22 production technologies had very poor adoption levels. These technologies are; "use of kocider 1011, captain, benlate or cypravate to control leaf spot disease", "2nd mulching done at maturity and crop left un-harvested as storage method" and "use of inorganic fertilizer (NPK 15:15:15 at 300 kg/ha in split doses)". With a mean pooled at 85.28%, the findings show that the improved ginger production technologies have actually been disseminated to the farmers at different awareness levels. On the other hand, the findings also reveals that majority of the technologies have been adopted by both male and female ginger farmers at different levels, although the male respondents had high adoption level (2.59) than their female counterparts (2.43) which was less than 2.5.

Access to and Control over Production Resources in Ginger Production

Result in Table 3 shows that the male ginger farmers had full access to production resources in ginger production than their female counterparts in South East Nigeria. This was revealed by the mean score value of 2.57 on a 3-point graphic rating scale, which was above the

average mean value of 2.0. This means that the male farmers had easy access to information and production resources in ginger production than their female counterparts. This implies that the ability to access production resources or technology easily by the male farmers, could lead to an increase in the tendency of the male farmers to adopt the improved technologies which would in turn increase their yield. On the other hand, the female farmers had limited access to the same resources with a mean score of 1.98. This implies that access to production resources in ginger production was difficult for the female farmers compared to their male counterparts. This could affect crop yield as there is a correlation between access to production resources, adoption of production technologies and crop yield. The result further shows that the male respondents had full control over production resources than their female counterparts. Their mean values were 2.46 for the male and 1.82 for female. This implies that the female ginger farmers had limited access to and control over production resources in the South Eastern region. This could affect their adoption levels hence yield, as these resources are needed for production. Furthermore, the findings show that both the male and female farmers were fully involved in decision making in the study area. This was revealed by a mean score rating of 2.74 for males and 2.61 for female. The mean scores for both male and female were above the average mean value of 2.0 which implies that both male and female farmers in the South-East were equally involved in decision making in ginger production. This disagrees with the claims of Makarau, Rabiu, Mohammed, Anna, Yakubu and Gadzama (2013*),* who reported that leadership roles vis-a- vis decision making are dominated by the men folk.

Results in Table 4 show the Z-test analysis of comparison of yield between male and female adopters of improved ginger production technologies in South-East, Nigeria. The result shows a Z-statistic of 1.82 for yield which was significant at 10% level of probability, indicating significant difference in yield between male and female ginger farmers in the study area. The male (10.9t/ha) ginger farmers performed slightly higher than their female (10.32776t/ha) counterparts. From the finding, the value of Z-statistic computed (1.8268*), was greater than Z-statistic tabulated at 10% level. Therefore the null hypothesis which states that there is no significant difference in ginger yield between male and female ginger farmers in South-East Nigeria is hereby rejected.

Conclusion

The study concludes that gender had a significant effect on ginger yield in South East Nigeria. Awareness and adoption levels of ginger production technologies were quite high in the South East, but higher among the male farmers. Male ginger farmers had greater access to and control over production resources than their female counterparts; whereas both male and female farmers were fully involved in decision making as regards ginger production which could influence their adoption levels, hence yield. Adoption of improved ginger production technologies had a significant effect on ginger yield in South East Nigeria. Based on the findings, it is recommended that the government should reduce gender gap in the access to, and control of resources by formulating policies aimed at encouraging women; to own lands as well as providing special loans specifically for female ginger farmers to enable them increase their productivity, thereby improving the yield of ginger in the region.

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Table 1: Distribution of respondents according to socio-economic characteristics

Variables	Female		Male		Pooled	
	Frequency	%	Frequency	%	Frequency	%
Farm size (Hectares)						
<0.1-1.0	120	96	91	72.8	211	84.4
1.1-2.0	4	3.2	11	8.8	15	6
2.1-3.0	1	0.8	14	11.2	15	6
>3.0	0	0	9	7.2	9	3
Mean $\bar{x}$	**0.6932**		**1.3028**		**0.998**	
Farm income (Naira)						
<100,000-300,000	29	23.2	37	29.6	66	26.4
3000,001-600,000	53	42.4	36	28.8	89	35.6
600,001-900,000	34	27.2	16	12.8	50	20
>900,000	9	7.2	36	28.8	45	18
Mean $\bar{x}$	**₦513012.8**		**₦971,436.66**		**₦715,224.73**	
Quantity of Ginger produced per annum (tonnes)						
<1-5	43	34.4	49	39.2	92	73.6
6-10	54	43.2	30	24	84	67.2
11-15	25	20	16	12.8	41	32.8
16-20	3	2.4	8	6.4	11	8.8
>20	**-**	-	22	17.6	22	17.6
Mean $\bar{x}$	**7.598**		**13.85**		**10.73**	
Yield of Ginger (tonnes/hectare)						
<1-5	1	0.80	6	4.8	7	5.6
6-10	53	42.4	64	51.2	117	93.6
11-15	66	52.8	49	39.2	115	92
16-20	5	4	5	4	10	8
>20	-	-	1	0.80	1	0.80
Mean $\bar{x}$	**10.33**		**10.96**		**10.64**	

Source: Field survey (2018)

Table 2: Distribution of respondents by awareness and adoption levels of ginger production technologies disseminated to ginger farmers in South-East Nigeria

S/no	Ginger production technologies disseminated by NRCRI	Awareness Level of disseminated ginger production technologies (%)			Adoption Level of disseminated ginger production technologies (mean)		
		Male	Female	Pooled	Male	Female	Pooled
1	Site selection (sandy clay loam-clayey loam)	99.2	100	99.6	2.99	2.67	2.83
2	Sett size (20g)	97.6	92.8	95.2	2.5	2.66	2.58
3	Manure application (2 weeks before planting)	99.2	100	99.6	2.99	2.74	2.87
4	Land preparation (planting on beds)	100	100	100	3	2.88	2.94
5	Timely planting (April- May)	100	100	100	2.62	2.53	2.57
6	Spacing (20cm x 20cm)	80	80	80	2.36	2.58	2.47
7	Improved varieties UG1 and UG2	100	100	100	3	2.96	2.98
8	1st Mulching (immediately after planting)	78.4	76.8	77.6	2.99	2.79	2.89
9	Weeding (4 weeks after planting WAP)	97.6	99.2	98.4	2.7	2.71	2.71
10	Use of grass mulch	76	75.2	75.6	2.77	2.5	2.64
11	Use of broad leaves mulch	74.4	76.2	76.8	2.11	2.38	2.24
12	Intercropping ginger with leguminous crops	96.8	92	94.4	2.27	2.3	2.28
13	Use of pre-emergence herbicides (Oxadiazon)	97.6	96	96.8	2.89	2.22	2.56
14	Use of inorganic fertilizer (NPK 15:15:15 at 300 kg/ha in split doses)	88	72.8	80.4	2.73	1.97	2.35
15	Use of cow dung at 8tonnes/ha + NPK 15:15:15 at 200kg/ha	62.4	52	57.2	2.31	2.12	2.22
16	Use of poultry dung + palm bunch ash at 6tonnes/ha	96	94.4	95.2	2.55	2.66	2.61
17	Use of poultry dung alone at 4tonnes/ ha	97.6	99.2	98.4	2.82	2.52	2.67
18	Use of Z-force to control leaf spot disease	71.2	72	71.6	2.63	2.6	2.62
19	Use of Kocider 1011, captain, benlate or cypravate to control leaf spot disease.	65.6	65.6	65.6	1.62	1.54	1.58
20	Use of NPK 20:20:20 fertilizer at 250kg/ha	81.6	68.8	75.2	2.51	2.14	2.32
21	2nd mulching done at maturity and crop left un-harvested as storage method	66.4	50.4	58.4	1.83	1.37	1.6
22	Timely harvesting (7 to 8 MAP)	80.8	82.4	81.6	2.94	2.7	2.82
23	Mean	86.65	83.9	85.28	2.59	2.43	2.52

Source: Field Survey, 2018. Multiple Responses were recorded

Table 3: Mean score responses of the respondents based on access to and control over production resources in ginger production in South East Nigeria.

Gender Indicators	Full Access		Limited Access		No Access		Mean	
	Male	Female	Male	Female	Male	Female	Male	Female
Access to production resources	72(216)	10(30)	52(104)	103(206)	1(1)	12(12)	2.57	1.98
Control over production resources	80(240)	9(27)	23(46)	84(168)	22(22)	32(32)	2.46	1.82
Involvement in decision making in Ginger production	93(279)	85(255)	31(62)	31(62)	1(1)	9(9)	2.74	2.61

Source: Field Survey, 2018. Multiple Responses were recorded
(*) figures in parentheses are response frequencies. Keys: Full access = >2.0; Limited access =1.5-2.0; and No access = <1.5

Table 4: Z-test analysis of difference in ginger yield between male and female ginger farmers

Variable	Number	Mean	Standard deviation	Standard error	Z-statistics	Df	Pr>t
Yield male	125	10.95848	2.447565	.2189169	1.8268*	248	0.0473
Yield Female	125	10.32776	2.984846	.2669727			

Source: STATA 8A results. Df =degree of freedom. *, **, and *** significant at 10%, 5% and 1% level of probability respectively. $H0_4$ rejected at 10% alpha level