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Differentials in Adoption of Improved Ginger Production Technologies among Male and Female Farmers in South-East, Nigeria

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Abstract
The study analyzed the adoption level of improved ginger production technologies by male and female farmers in South-East Nigeria. Multi-stage sampling 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 (means, percentages; five-point Likert-type rating scale) and inferential (Z-test) statistics. The result of the descriptive statistics indicates that the improved ginger production technologies have actually been disseminated to the ginger farmers in South East Nigeria; although awareness level was higher for the male farmers compared to their female counterparts. The adoption level of improved ginger production technologies was pooled at 84%. The mean adoption index of the male adopters was 2.59, whereas that of their female counterparts was 2.43. This implies that male ginger farmers' adoption level was 5.33% higher than the females which shows that adoption level was higher among male ginger farmers than their female counterparts. The result further shows that paucity of funds (4.73) male and (4.75) female, inadequate/lack of access to credits (4.72) male and (4.57) female, and inadequate storage facilities (4.68) male and (4.71) for female were the most severe constraints militating against the adoption of improved ginger production technologies by the ginger farmers in the region amongst others. The Z-test result showed that significant differences exist in the adoption levels of male and female ginger farmers, with a Z-value of 2.85 which was positive and significant at 5% level. This implies that gender had a significant effect on the adoption of improved ginger production technologies in South-East Nigeria, indicating that the male ginger farmers performed better than their female counterparts in terms of adoption. The study concluded that adoption of improved ginger production technologies was higher among male farmers than their female counterparts in South-East Nigeria. Therefore, the study recommends that the National Root Crops Research Institute (NRCRI) and other agencies interested in promoting ginger production should target female farmers and also concentrate on the constraints as well as technologies with low adoption in order to increase adoption.

Keywords: Adoption, Gender, Technology, Awareness and Ginger farmers

Introduction

Nigeria's ginger is highly valued in the international market for its high oil and oleoresin content (All Things Ginger 2012 in Ibeneme, 2021). According to Amadi, Ewuziem, Njoku, Nwaogu, Danbaba, and Ebeniro, (2013) ginger production steadily increased and averaged 128,256 metric tons from a harvested area of 133,766 hectares in the last decade. Also, Nigeria's production of ginger in 2021 increased from 647,990.52 tonnes in 2019 to 768,304.92 tonnes growing at an average annual rate of 28.93% (Knoema, 2022). From 1974, the National Root Crops Research Institute (NRCRI), Umudike, took leadership of, and embarked on rigorous and active research into the genetic improvement, production, processing, storage, utilization and marketing of root and tuber crops of economic importance in Nigeria (NRCRI, 2009). The mandate crops are cassava, yam, sweet potato, cocoyam, ginger, potato, sugar beet, turmeric, rizga and Hausa potato (Nwosu, 2004). The Institute 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). With regards to ginger, these technologies as indicated by Makarau, Rabiu, Mohammed, Anna, Yakubu and Gadzama, (2013) include bundling of improved rhizomes with appropriate specifications and inputs (fertilizer, herbicide and fungicide applications) etc.

According to Caswell, Fuglie, Ingram, Jans and Kascak (2001); Okoye, Okoye, Nwankwo, Eluwa and Madu, (2012), the most important determinant of the effectiveness of research results is the level of adoption of innovations that it generates, and on their profitability. However, a common problem for many individuals and organization is how to speed up the rate of diffusion of research programs innovation (Okoye *et al*., 2012). Hence, for a successful adoption of a technology; farmers must not only know about it, but must be able to follow the recommendations given (Ejechi, Tologbonse, Adeniji, and Onu, 2013). Therefore, a thorough knowledge of the target group in the development and dissemination of the technology is a prerequisite to adoption of the technology in question. Also, the ability to increase food production in developing countries especially Nigeria has great gender implications; as farm operations that require a lot of energy such as land clearing and land preparation are predominantly carried out by men, while women predominantly carry out relatively lighter operations in the farm which include; processing, harvesting and storage (Madu, Okoye, Alozie, Ironkwe, Njoku and Edeoga, 2015).

However, gender gaps in terms of production in the agricultural sector are common phenomena in many developing countries especially among farmers as growth in the agricultural and rural sectors is threatened by gender-related constraints and unequal access to productive resources as well as opportunities (Ibeneme, 2021). There has been a misconception about gender as being the promotion of women only; nevertheless, gender focuses on the relationship between men and women, their roles, access to and control over resources, division of labor and needs. In view of the foregoing, therefore, this paper seeks to analyze the adoption level of improved ginger production technologies by male and female farmers in South-East, Nigeria. The specific objectives include to: ascertain the level of awareness of the improved ginger production technologies disseminated to the male and female ginger farmers; assess the level of adoption of improved ginger technologies; and determine the constraints militating against the adoption of improved ginger production technologies in South-East Nigeria.

Hypothesis

Ho: There is no significant difference in the adoption of improved ginger production technologies by male and female ginger farmers in South East Nigeria.

Methodology

This study was conducted in South-East Geo-Political Zone of Nigeria. The Zone is 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 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 these area. In 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; of which, 20% was allotted to Anambra, while 40% was allotted to Abia and Imo respectively. 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 respectively, giving an aggregate of 250 respondents which constituted 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

The level of awareness of the improved technologies in ginger production disseminated to the ginger farmers in South East Nigeria were ascertained using descriptive statistic tools such as means, frequencies, percentages and tables. The level of adoption of improved ginger production technologies by farmers was determined by a 3- point graphic rating scale designed to measure farmers' adoption level as used by (Agbarevo, 2015). The farmers were asked to indicate their adoption level to ginger production technologies. 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.

This can be summarized in the equation below:

$$Xs = \sum fn/N$$

where Xs = mean score

$\sum$ = summation

f = frequency

n = Likert nominal value

N = Number of the respondents

$$Xs = \frac{1+2+3}{3} = \frac{6}{3} = 2$$

The constraints militating against the adoption of improved ginger technologies in the area were determined using a five-point Likert rating scale. The response options and assigned values were: very severe constraint =5, severe constraint =4, moderately severe constraint =3, low constraint =2 and no constraint =1. List of possible constraints were supplied, from which the respondents were asked to indicate the extent of their perceived seriousness of each constraint according to the response options provided. Respondents with mean score of 3.0 and above implied that the constraints are serious, while respondents with mean score of less than 3.0 implied not serious. To determine the mean Likert level = Xs = 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 below:

$Xs = \sum fn/N$

where Xs = mean score

$\sum$ = summation

f = frequency

n = Likert nominal value

N = Number of the respondents

$$Xs = \frac{1+2+3+4+5}{5} = \frac{15}{5} = 3$$

Z-test was used to test the hypothesis that there is no significant difference in the adoption of improved ginger production technologies between male and female ginger farmers. The choice of Z-test to test the hypothesis is because n >30.

$$Z_{cal} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\delta^2 \bar{x}_1}{n_1} + \frac{\delta^2 \bar{x}_2}{n_2}}} \quad \ldots\ldots\ldots (1)$$

Where Z = calculated value

$\bar{X}_1$ = Mean adoption level of male ginger farmers

$\bar{X}_2$ = Mean adoption level of female ginger farmers

$\delta\bar{X}_1$ = Sample variance of male adopters

$\delta\bar{X}_2$ = Sample variance of female adopters

n_1 = Sampled number of male adopters

n_2 = Sampled number of female adopters

Decision: if $Z_{cal} > Z_{tab}$ at ($P \leq 0.05$) we reject the null hypothesis

Results and Discussion

Awareness level of ginger production technologies disseminated in South-East, Nigeria

The level of awareness of improved ginger production technologies disseminated to the ginger farmers in South-East Nigeria is presented on Table 1. Descriptive statistics were used. Twenty two (22) improved ginger production technologies disseminated to the farmers by NRCRI were listed for farmers to identify and ascertain their level of awareness. Out of the 22 technologies listed, majority of the male and female ginger farmers indicated aware of all the technologies at different levels, although awareness level was higher for the male farmers compared to their female counterparts. The result shows that land preparation (planting on beds), timely planting (within April-May), and use of improved varieties (UG1 and UG2) had the highest awareness levels (100%) for both male and female farmers. Site selection (planting on sandy clay loam-clayey loam) and manure application (done two weeks before planting) had highest awareness level (100%) for the female respondents, while the male respondents had 99.20% awareness level for both technologies respectively. The result also shows that majority (80%) and (65.60%) of the male ginger farmers affirmed their awareness of spacing (20 x 20)cm and the use of fungicide (kocider 1101, captain, benlate or cypravate) to control leaf spot disease respectively. The same was applicable to their female counterparts. This implies that both male and female ginger farmers were at the same awareness level for both technologies. About 49.60% and 48% of the female respondents were unaware of the 2nd mulching (done at maturity) and the use of cow dung + NPK 20:10:10 fertilizer, while only 33.60% and 37.60% of the male respondents were unaware of the same technologies. This implies that farmers need to be more enlightened on these technologies as they are important technologies in ginger production. Generally, the findings show that the improved ginger production technologies have been actually disseminated to the farmers of which majority but not all the farmers are aware of the entire innovations. This result agrees with the findings of Makarau *et al*. (2013), who observed similar awareness levels among ginger farmers in the North. Mbanaso *et al.* (2012) also noted that awareness is of advantage to the adoption of the sweet potato production technology, being an indispensable and preceding step towards the adoption of any improved practice.

Level of Adoption of Improved Ginger Production Technologies among Ginger Farmers

The level of adoption of improved ginger production technologies by the respondents is presented on Table 2. The adoption levels were determined using a 3-point graphic rating scale of: Never adopted =1, Adopted and stopped =2, and Adopted and still using innovation=3 as used by Agbarevo (2015). This was further modified into: (>2.5) = High adoption level; (2-2.5) = moderate adoption level and (<2.00) = very poor adoption level. The result shows that only two (2) out of the 22 production technologies had very poor adoption levels by the male ginger farmers. The technologies are, use of kocider 1011, captain, benlate or cypravate to control leaf spot disease (1.62) and 2nd mulching done at maturity and crop left un-harvested as storage method (1.83). This implies that the levels of adoption of the improved ginger production technologies by the male ginger farmers were generally high as 16 out of 22 innovations disseminated were fully adopted and still in use by the male respondents. This suggests adequate and sufficient exposure of the male ginger farmers to the production technologies by the research. On the other hand, only three (3) out of the 22 production technologies had very low adoption rates recorded by the female ginger. These technologies include; the use of inorganic fertilizers (1.97), use of kocider 1011, captan, benlate or cypravate to control leaf spot disease (1.54), and the 2nd mulching at maturity and crop left un-harvested as storage method (1.37). This may be as a result of the high cost of these technologies. The study shows that all the respondents used at least one technology out of the 22 improved ginger production technologies introduced to the farmers in the study area. Generally, the finding depict 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 levels than their female counterparts who had moderate adoption level.

Gender Differences in Level of Technology Adoption

The adoption level refers to the intensity of use of improved technology by the farmers measured using their adoption scores. The adoption mean score generated shows to what extent the farmers have adopted the whole technology package. The adoption level of improved ginger production technologies for South-East ginger farmers was 84%. The level of adoption by gender shows that adoption level was higher among male farmers than their female counterparts. From Table 3, the mean adoption index of the male adopters was 2.59, while that of their female counterparts was 2.43. This implies that male ginger farmers' adoption level was 5.33% higher than the females. This might be because male farmers have better access to information and other resources on improved production technology than their female counterparts.

Constraints militating against Adoption of Improved Ginger Production Technologies

Identified constraints faced by farmers in the production of ginger in South East Nigeria are presented on Table 4. As indicated by Ejechi *et al.* (2013), the inability to have maximum adoption rate of a given technology among the farmers groups could be attributed to the existence of various problems associated with adoption of the technology. In view of this, determination of the constraints faced by farmers in the adoption of improved ginger production technologies in the South-East was achieved using a five-point Likert-type rating scale. The response options and assigned values were: very severe constraint =5, severe constraint =4, moderately severe constraint =3, low constraint =2 and no constraint =1. From the list of possible constraints supplied, the respondents were asked to indicate the extent of their perceived seriousness of each constraint according to the response options provided. The result shows that paucity of funds (4.73), inadequate/lack of access to credits (4.72), and inadequate storage facilities (4.68) were the most severe constraints militating against the adoption of improved ginger production technologies by the male ginger farmers in South-East Nigeria. Other severe constraints were unavailability of farm inputs (4.25), cost of the technology (4.07), and insufficient equipment (4.10). On the other hand, female farmers indicated that paucity of funds (4.75), inadequate storage facilities (4.71), and inadequate credit (4.57) were the most severe constraints faced by the females farmers which militates against the adoption of improved ginger production technologies in the region. Whereas, unavailability of farm inputs (4.46), poor extension services/ contacts (4.34), insufficient equipment (4.26), frequent price fluctuations of ginger (4.05) and lack of technical know-how (4.02) were also severe constraints. This finding conforms to Iheke (2010) who asserted that paucity of fund for adoption of the technology was a persistent problem in the adoption process. The result also agrees with Onyebinama and Udensi (2013) who asserted that the lack of adequate and appropriate agricultural credit is one of the fundamental constraints to agricultural production in the country.

Results in Table 5 show the Z-test analysis of comparison of adoption level between male and female ginger farmers in the adoption of improved ginger production technologies. The result shows a Z statistic of 2.85 which was significant at 5%level of probability indicating significant difference in the adoption level of male and female ginger farmers. The results show that the male farmers adopted the improved technologies more than their female counterparts with a mean of 86.33 higher than 81.00. Therefore, the null hypothesis which states that there is no significant difference in the adoption of improved ginger production technologies between male and female ginger farmers is hereby rejected.

Conclusion

The result of this study shows that significant differences exist in the adoption levels of male and female ginger farmers in South East Nigeria. It further concludes that gender had a significant effect on the adoption of improved ginger production technologies, as male ginger farmers performed better than their female counterparts in terms of awareness and adoption. The study also shows that paucity of funds, inadequate/lack of access to credit facilities and lack of storage facilities amongst others were the most severe constraints militating against ginger production in South-East Nigeria. Hence, on the basis of the findings made, the study recommends that the National Root Crops Research Institute (NRCRI), agricultural extension agencies and other related agencies interested in promoting ginger production, should target female farmers; intensify efforts in disseminating improved production technologies especially to women to support their efforts in ginger production in order to increase adoption. Furthermore, to overcome the constraint of inadequate storage facilities as observed in the study, it is recommended that more extension agents should be deployed to the field to continue to sensitize the ginger farmers on the importance of the "2nd mulching at maturity and crop left un-harvested" technology, which is an imperative cultural practice in ginger production as this would help reduce losses incurred from rhizome spoilage as well as serve as rhizome storage method.

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Table 1: Distribution of respondents by awareness of ginger production technologies disseminated to ginger farmers in South-East Nigeria

Improved ginger production technology disseminated by NRCRI	Aware of disseminated improved ginger production technologies			Unaware of improved ginger production technologies		
	Male n=125	Female n=125	Pooled n=250	Male n=125	Female n=125	Pooled n=250
Site selection (sandy clay loam- clayey loam)	124 (99.20)	125 (100)	249 (99.60)	1 (0.80)	0 (0)	1 (0.40)
Sett size (20g)	122 (97.60)	116 (92.8)	238 (95.20)	3 (2.40)	9 (7.20)	12 (4.80)
Manure application (2 weeks before planting)	124 (99.20)	125 (100)	249 (99.60)	1 (0.80)	0 (0)	1 (0.40)
Land preparation (planting on beds)	125 (100)	125 (100)	250 (100)	0 (0)	0 (0)	0(0)
Timely planting (April- May)	125 (100)	125 (100)	250 (100)	0 (0)	0 (0)	0 (0)
Spacing (20cm x 20cm)	100 (80)	100 (80)	200 (80)	25 (20)	25 (20)	50 (20)
Improved varieties UG1 and UG2	125(100)	125 (100)	250 (100)	0 (0)	0 (0)	0 (0)
1st Mulching (immediately after planting)	98 (78.40)	96 (76.8)	194 (77.60)	27 (21.60)	29 (23.20)	56 (22.40)
Weeding (4 weeks after planting WAP)	122 (97.60)	124 (99.2)	246 (98.40)	3 (2.40)	1 (0.80)	4 (1.60)
Use of grass mulch	95 (76)	94 (75.20)	189 (75.60)	30 (24)	31 (24.80)	61 (24.40)
Use of broad leaves mulch	93 (74.40)	99 (76.20)	192 (76.80)	32 (25.60)	26 (20.80)	58 (23.20)
Intercropping ginger with leguminous crops	121 (96.80)	115 (92)	236 (94.40)	4 (3.20)	10 (8)	14.(5.60)
Use of pre-emergence herbicides (Oxadiazon)	122 (97.60)	120 (96)	242 (96.80)	3 (2.40)	5 (4)	8 (3.20)
Use of inorganic fertilizer (NPK 15:15:15 at 300 kg/ha in split doses)	110 (88)	91 (72.80)	201 (80.40)	15 (12)	34 (27.20)	49 (19.60)
Use of cow dung at 8tonnes/ha + NPK 15:15:15 at 200kg/ha	78 (62.40)	65 (52)	143 (57.20)	47 (37.60)	60 (48)	107 (42.80)
Use of poultry dung + palm bunch ash at 6tonnes/ha	120 (96)	118 (94.4)	238 (95.20)	5 (4)	7 (5.60)	12 (4.80)
Use of poultry dung alone at 4tonnes/ ha	122 (97.60)	124 (99.20)	246 (98.40)	3 (2.40)	1 (0.80)	4 (1.60)
Use of Z-force to control leaf spot disease	89 (71.20)	90 (72)	179 (71.60)	36 (28.80)	35 (28)	71 (28.40)
Use of Kocider 1011, captain, benlate or cypravate to control leaf spot disease.	82 (65.60)	82 (65.60)	164 (65.60)	43 (34.40)	43 (34.40)	86 (34.40)
Use of NPK 20:20:20 fertilizer at 250kg/ha	102 (81.60)	86 (68.80)	188 (75.20)	23 (18.40)	39(31.20)	62 (24.80)
2nd mulching done at maturity and crop left un-harvested as storage method	83 (66.40)	63 (50.40)	146 (58.40)	42 (33.60)	62 (49.60)	104 (41.60)
Timely harvesting (7 to 8 MAP)	101 (80.80)	103 (82.40)	204 (81.60)	24 (19.20)	22 (17.60)	46 (18.40)

Source: Field Survey, 2018

Multiple Responses were recorded

( ) figures in parentheses are response percentages

Table 2: Mean score responses of the respondents based on level of adoption of improved ginger production technologies

Improved Ginger technologies	Male	Female	Pooled
Site selection (sandy clay loam- clayey loam)	2.99	2.67	2.83
Sett size (20g)	2.50	2.66	2.58
Manure application (2 weeks before planting)	2.99	2.74	2.87
Land preparation (planting on beds)	3.00	2.88	2.94
Timely planting (April- May)	2.62	2.53	2.57
Spacing (20cm x 20cm)	2.36	2.58	2.47
Improved varieties UG1 and UG2	3.00	2.96	2.98
1st Mulching (immediately after planting)	2.99	2.79	2.89
Weeding (4 weeks after planting WAP)	2.70	2.71	2.71
Use of grass mulch	2.77	2.50	2.64
Use of broad leaves mulch	2.11	2.38	2.24
Intercropping ginger with leguminous crops	2.27	2.30	2.28
Use of pre-emergence herbicides (Oxadiazon)	2.89	2.22	2.56
Use of inorganic fertilizer (NPK 15:15:15 at 300 kg/ha in split doses)	2.73	1.97	2.35
Use of cow dung at 8tonnes/ha + NPK 15:15:15 at 200kg/ha	2.31	2.12	2.22
Use of poultry dung + palm bunch ash at 6tonnes/ha	2.55	2.66	2.61
Use of poultry dung alone at 4tonnes/ ha	2.82	2.52	2.67
Use of Z-force to control leaf spot disease	2.63	2.6	2.62
Use of Kocider 1011, captain, benlate or cypravate to control leaf spot disease.	1.62	1.54	1.58
Use of NPK 20:20:20 fertilizer at 250kg/ha	2.51	2.14	2.32
2nd mulching done at maturity and crop left un-harvested as storage method	1.83	1.37	1.60
Timely harvesting (7 to 8 MAP)	2.94	2.70	2.82
Mean Adoption	2.59	2.43	2.52

Source: Field Survey, 2018. Multiple Responses were recorded

Table 3: Adoption index by gender

Gender	Percentage	Mean adoption
Male	86.33	2.59
Female	81.00	2.43

Source: field survey, 2018

Table 4: Constraints militating against the adoption of improved ginger production technologies

Constraints	Male	Female	Pooled
Small farm size	2.62	2.73	2.67
Low yields of ginger	2.24	1.92	2.08
Lack of access to improved varieties	2.30	2.66	2.48
High cost of the technology	4.07	3.59	3.83
Herdsmen attack	2.84	2.64	2.74
Flooding	2.76	2.38	2.57
Old age	2.01	1.35	1.68
Unavailability of lands/ land tenure system	3.14	3.95	3.54
Lack of technical know-how	3.51	4.02	3.77
Poor extension services/contact	3.94	4.34	4.14
High illiteracy level	2.14	1.99	2.07
Inadequate labor or high labour cost	3.70	3.97	3.84
Insufficient equipment	4.10	4.26	4.18
Inadequate credit	4.72	4.57	4.64
Low ginger prices at harvest	3.58	3.66	3.62
Unavailability of farm inputs	4.25	4.46	4.35
Paucity of funds	4.73	4.75	4.74
Complexity of technology	3.34	3.17	3.25
Inadequate rainfall	1.30	1.44	1.37
Frequent price fluctuations of ginger	3.98	4.05	4.02
Inadequate storage facilities	4.68	4.71	4.70
Late maturity of crop	1.31	1.13	1.22

Source: Field Survey, 2018. Multiple Responses were recorded

Keys: VSC-Very severe constraint (4.5-5), SC-Severe constraints (3.5-4.49), MC-Moderately severe (2.5-3.49) constraint, LC-Low constraints (1.5-2.49) and NC-No constraints (1-1.49)

Table 5: Z-test analysis of adoption level of improved ginger production technologies between male and female ginger farmers

Variable	Number	Mean	Std. Dev	Std. Error	Z-statistics	Df	Pr>t
Male Adoption level	125	86.33	5.93374	.5307298	2.85**	248	0.0072
Female Adoption level	125	81.00	7.125941	.6373636			

Source: STATA 8A results. Df =degree of freedom. ** is significant at 5% level of probability. $H0_3$ rejected at 5% alpha level