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ANALYSIS OF SMALLHOLDER FARMERS' ACCEPTANCE OF IMPROVED TOMATO SEED VARIETIES IN KANO RIVER IRRIGATION PROJECT (KRIP) KANO STATE, NIGERIA

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ABSTRACT
The study analyzed smallholder farmers' acceptance of improved tomato varieties in Kano River Irrigation Project (KRIP) Kano State. The KRIP areas include; Kura, Bunkure and Garun Mallam. Multistage sampling technique was used to select 181 tomato farmers. Data were collected using structured questionnaires and analyzed using descriptive statistics, logit regression, technology acceptance model and Likert scale. The findings revealed that majority of the farmers were male and educated with mean age of 37 years; 56% had a mean household size of 8 people and 79.6% with a mean of 0.83 hectare of land while about 73% had a mean of 12 years' experience. Results further revealed that gender (-0.998), educational status (-0.599), household size (-0.104), farming experience (-0.130) and credit access (-0.964) had positive influence on farmers' acceptance of UC82B, Riogrande and Chibli, respectively, while farm size was significant ($P \leq 0.01$) and had negative coefficient on the acceptance of all varieties. Technology acceptance model result reported a positive outcome in terms of ease of usage, perceived attitude, perceived usefulness and intention to continue use for all the varieties. Price instability (72.90%), pest and disease problem (63.00%) and inadequate supply of irrigation water (56.40%) were the main challenges holding back the development of tomato production enterprise. The study concluded that farmers strongly preferred UC82B variety than any other variety and acceptance of new improved tomato varieties is conditioned by farmer perception and preferences. It was recommended that farmers should be encouraged to construct mud cooling chamber in their farms to reduce postharvest loss and market glut; government and non-governmental agencies should provide pesticides at a more subsidized rate; and there is also need for investment in water infrastructure.

Keywords: Improved tomato varieties, Logit regression, Perception, technology acceptance model.

INTRODUCTION
Tomato *(Solanum lycopersicum)* is one of the most important edible and nutritious vegetable crop, widely cultivated in tropical, sub-tropical and temperate climates in the world, it is also considered as an important cash and industrial crop in many parts of the world (Babarinsa and Ige, 2014). Tomato is a member *Solanaceae* family known as berry and is the second most important vegetable crop next to potato. It is beneficial to human health being rich in minerals, vitamins, essential amino acids, sugars and low in fat, calories and dietary fibers. The world production of tomato totaled 170.8 million tons which is cultivated on approximately 3.7 million hectares of land. China is the leading producer of tomatoes, accounted for 31% of the total production. India and the United States followed as second and third highest production of tomatoes in the word, respectively. The top 8 tomato producing countries are; China (52.6 MT), India (18.7 MT), United states (14.5 MT), Turkey (11.9 MT), Egypt (8.3 MT), Iran (6.0 MT), Italy (5.6 MT) and Spain (4.9 MT) (FAOSTAT, 2014).

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In Nigeria, and many parts of Sub-Saharan Africa, tomato is considered as important vegetable and it's mainly grown by rural small farm-holders and its importation supplement local production. Nigeria was reported to be the second largest producer of tomato in Africa after Egypt and 13th in the world, with a production of 1.8 million tons which accounts for about 68.4% of West Africa, 10.8% of Africa's total output and 1.28% of world output (FAOSTAT, 2014). Despite Nigeria being the second largest producer of tomato in Africa, yet, Nigeria imported 189,510.11 MT of tomato paste which is equivalent to 1,042,305.68 MT of fresh tomatoes between 2015 and 2016 (FAOSTAT, 2016). Although efforts have been made toward revitalizing the agricultural sector by prioritizing some crops for accelerated production and preservation in Nigeria, tomato is not on the list of priority crops, hence importation of tomato puree had continue (Ugonna *et al.,* 2015).

Improved tomato seed varieties developed by the national and international agricultural research centers very often fail to get accepted by smallholder farmers partly because farmers have different needs (Ajagbe *et al.,* 2014). They require tomato seeds of diverse attributes and of multiple traits (high yield, disease and drought tolerance, colour, size, days to maturity etc.). This depends on crop variety traits or attributes, which are the performance characteristics of plant varieties that include both the production (agronomic) capacity of the plant and the consumption attributes of the product (Sibiya *et al.,* 2013).

In the same development, smallholder farmers often prefer open pollinated varieties (OPVs) because they can be recycled for a longer period and the price is relatively lower compared to improved seeds. It is generally accepted that access to improved seeds is an important factor for increasing agricultural productivity among smallholder farmers (Olayemi *et al.,* 2010). However, such access is constrained by weak seed supply systems, which has been identified as a limiting factor for achieving widespread usage of improved seed varieties in sub-Saharan African (SSA) countries (Olayemi *et al.,* 2010).

Smallholder farmers continue to use local elite and recycled tomato varieties. However, seed recycling reduces crop yield. Samaila (2009) showed that continued recycling of seeds was responsible for persistent yield reduction among smallholder farmers. It has also been reported that recycling OPVs seed varieties beyond the recommended duration can lead to yield reduction of up to 5%. Meanwhile, recycled hybrid seed yield reduction can be as high as 32% (Pixley and Banziger, 2002).

In order to enhance the usage of improved seed, food security and rural welfare, small scale farmers who constitute the majority of Farmers in Nigeria, should among other things be involved in all processes of tomato variety selection and evaluation so that seed that are bred and sold are preferred by farmers. Most breeders of improved tomato seed varieties have focused on raising yields, as well as addressing drought and disease tolerance. However, farmers perceive little

Prevailing studies have been mostly directed on adoption, marketing performance and production and profitability of tomato varieties. Specifically, there have been limited efforts in investigating the effect of farmers' acceptance and perception on characteristics of new varieties on their acceptance and wider dissemination in the study area. The broad objective of the study is to analyze the smallholder farmers' acceptance of improved tomato varieties in Kano River Irrigation Project (KRIP). Other objectives are to; determine the socio-economic factors influencing the use of improved tomato varieties, examine farmers' preference of improved tomato seed varieties, assess the acceptance level of improved tomato seed varieties, perception level about the effectiveness of improved tomato seed varietal attributes, , and describe the constraints affecting the tomato farmers in the study area.

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MATERIALS AND METHODS

The Study Area

The study was carried out in Kano River Irrigation Project in Kano State, located between latitudes 13^0 N and 11^0 S and longitude 8^0 W and 10^0 E. Kano State has a land mass of about 20,760km^2. As at 2014, the State has projected National Population Commission (NPC) figures of 11,923,539 with annual growth rate of 3.2% (NPC, 2006). The State is agrarian, as more than 65 percent of the working adults are engaged in farming and farm related activities for their means of livelihood. The average annual rainfall is 700mm, with the mean daily maximum and minimum temperatures of 35^0 and 19^0 Celsius respectively. According to National Agricultural Extension and Research Liaison Services [NAERLS] (2014), the major crops grown in the State include rice, millet, maize, cowpea, vegetables and groundnut (NAERLS, 2014).

Kano River Irrigation Project (KRIP) is one of the pioneer large scale public irrigation schemes in Nigeria. KRIP was established in 1969 in Kano state. The project has potential for irrigating 62,000 hectares of land, but only the first phase (KRIP), which covers an irrigable area of 25,606 ha, has been completed. This area revolves around Kura, Bunkure and Garun Mallam Local Government Areas (LGAs), and is known for tomato activities. The major tomato production and marketing activities are carried out around KRIP areas (NAERLS, 2014).

Sampling Techniques

A Multi-stage sampling was used for the study. The first stage involved purposive selection of KRIP areas noted for high tomato production. The areas are; Kura, Garun Malam and Bunkure LGAs. Second stage employed purposive selection of two (2) villages each from KRIP areas due to their intensive involvement in tomato production in the study area. Finally, third stage considered a random selection of tomato farmers. The sample size to be drawn from each village was determined using sample size determination formula following Alpizar *et al.* (2001). The mathematical formula is given as:

$$n = \frac{Z^2PqN}{e^2\,(N-1)+Z^2Pq} \qquad \ldots (1)$$

$$n = \frac{1.96^2(0.5 * 0.5 * 2425)}{0.07^2(2225-1) + 1.96^2 * 0.5 * 0.5} = \frac{2328.97}{12.838} = 181$$

where;
n = sample size;
N = population size;
P = population reliability (frequency estimated for a sample of size n);
q = 0.5 considered for all developing countries population and p + q= 1 (where q=1- p = 0.5);
e = 0.07 error margin; and
$\frac{Z\alpha}{2}$ = normal reduced variable at 0.05 level of significance/confidence level and z is 1.96.

Data Collection Procedure

Primary data for this study was collected using structured questionnaire with the help of enumerators. The questionnaire was designed in accordance with the objectives of the study.

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Analytical Tools

The objectives of the study were achieved using the data collected which were analyzed using descriptive (frequency distribution, percentages, mean and standard deviation) and inferential statistics (logit regression). The Logit regression model was specified as:

$$\gamma = \beta_0 + \beta n \sum_{123} Xni + Ui \quad \ldots(2)$$

where;
$\gamma =$ If a farmer who accept improved tomato variety and 0 if a farmer does not.
$X =$ independent variable
$ni = 1, 2, 3$……..n
$\beta_0 =$ intercept
$\beta n =$ regression parameters

The explicit form of the model is;

$$\gamma_{i=1,\ldots j} = \beta_0 + \beta_1 Ag + \beta_2 Gd + \beta_3 Ms + \beta_4 Hs + \beta_5 Ye + \beta_6 Fe + \beta_7 Fs + \beta_8 Cr + + \ Ui \quad \ldots(3)$$

where;
γ = varietal choice;
β_o = intercept;
β_1 Ag = age of the respondents (years);
$\beta_2 Gd$ = gender of the respondents (1 male, female 0) ;
$\beta_3 Ms$ = marital status (single 1, married 2, divorced 3, widowed 4);
$\beta_4 Hs$ = household size (number);
$\beta_5 Es$ = education status (years);
$\beta_6 Fe$ = years of farming experience (years);
$\beta_7 Fs$ = farm size (hectare); and
$\beta_8 Cr$ = Access to credit (yes 1, no 0);

RESULTS AND DISCUSSION

Socio-economic Characteristics of Tomato Farmers

The total size of plots or land dedicated for agricultural purpose and specifically for tomato production is revealed in Table 1. The result of the study revealed that majority of the farmers had between 0.50-0.90 hectares of land. This observation implies that tomato production in the study area is mainly small scale since the average size of land cultivated to tomatoes is below 1 hectare. This confirms the separate findings carried out by Usman and Bakari (2013) and Ahmed (2011) who reported that the average number of hectares cultivated per farmer was found to be 0-1.6 hectares.

Experience in farming is factor often highlighted playing an important role in accepting an innovation. Farmers will be more comfortable in using an innovation with which they are more familiar. Inferring from the results depicted in the Table 1 indicated that majority of the farmers had between 1-16 years of experience in tomato production. The results therefore suggest that farmers had gathered much experience that helps them adjust to uncertainties in their production process to enhance profitability. The findings support the findings of Ahmed (2011) who posited that majority of tomato farmers in Kano state had 21-30 years of experience

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in tomato production. Also Sanusi and Dada (2009) reported a low 11-15 years of farming experience in Ogun State.

Table 1: Socio-Economic Characteristics of Tomato Farmers

Age	**Frequency**	**Percentage**
Farm size (Ha)		
0.10 - 0.40	34	18.80
0.50 – 0.90	105	58.00
1.00 – 1.40	22	15.50
1.50 – 1.90	13	7.20
2.00 – 2.40	1	0.60
Total	181	100
Years of Farming Experience		
1 – 8	68	37.70
9 – 16	63	35.10
17 – 24	34	18.90
25 – 32	12	6.70
31 – 40	5	2.80
Total	181	100
Gender		
Male		
Female		81
Total	**181**	19
Educational Level		
Qur'anic	79	43.60
Primary	25	13.80
Secondary	56	30.90
Tertiary	21	11.60
Total	181	100

Gender is the natural segregation of human race in to male and female and each contribute toward faming activities among farming families. The results of Table 1 asserted that tomato farming in the study area are male dominated with a total of 80.70% males and 19.30% females. The observed pattern in the gender distribution is not surprising and could thus be attributed to the difficulty in females' accessibility or ownership of land in the area of study. Also, it is in line with the tradition of the area that usually the enterprise was done by male, but due to social changes that occur in our societies, female start realizing the importance of the tomato production and tend to venture into it. That is why they occupy certain percentage among the tomato farmers in the area. This is in line with studies of Haruna *et al.* (2012) and Emodi and Osilem (2018) who reported that males dominated tomato production in Bauchi and Taraba States, respectively.

Education is a form of learning in which the knowledge, skills and habits of group of people are transferred from one generation to the other through teaching learning and research. Education plays significant role toward decision making and the intellect that will enable farmers to read and understand, adopt and adapt improved production techniques to enhance

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productivity. The result of Table 1 also revealed that among the tomato farmers considered in the study, majority (43.60%) had Qur'anic education, (30.90%) attended secondary education, (13.80%) obtained primary education and (6.1%) acquired tertiary education. This implies that majority of the tomato farmers can be able to read and write in either western or Arabic which help in accessing, adapting and adopting innovation that will improve tomato production activities. This is line with the findings of Sanusi and Dada (2009) who opined tomato farming in Ogun state is dominated by the non-educated class with non-formal form of education. Emodi and Osilem (2018) posited that majority of tomato farmers in Taraba states acquired tertiary form of education.

Preferred Tomato Varieties

The result in Figure 1 reported that UC82B is the leading tomato variety as reported by majority (65.70%). Chibli was found to be the second most preferred improved tomato variety after UC82B variety as mentioned by 17.70% of tomato farmers and Riogrande was found to be the least preferred improved tomato variety as mentioned by 16.60% of tomato farmers. Adamu (2016) posited that majority of tomato farmers in Kano state preferred UC82B tomato variety simply because of low maturity days.

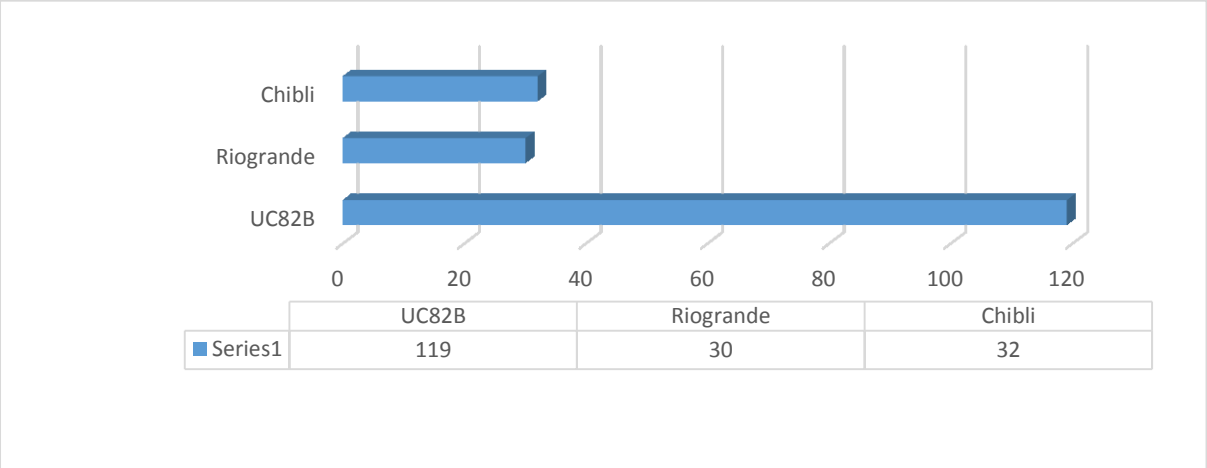

Figure 1: *Preferred tomato varieties*

The farmers' acceptance and perception on improved tomato varietal attributes according to Table 2 results revealed that UC82B improved tomato variety is found to be the leading variety in the study are in terms of ease of usage, perceived usefulness, affordability, resistance to pest and disease and maturity days scoring 92.46%, 81.88%, 98.15%, 64.03% and 81.35% respectively. Except that Chibli improved tomato variety happened to leading as reported by farmers with respect to productivity and shelf life with 92.50% and 98.13% respectively. This implies that UC82B variety had the ease of usage, perceived by the farmers as more useful, more affordable, and able to withstand pests and diseases and fewer maturity days in comparison to the other varieties. The results also showed that chibli, on the overall scale, had high level of productivity and stronger shelf life. If breeders could harmonize the above qualities of UC82B improved tomato variety couple with those of chibli improved tomato variety, which represented the majority of rice farmers in Kano being in KRIP area will produce a perfect variety for the tomato farmers for the whole Kano and perhaps for the whole northern Nigeria at large.

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Table 2: Farmers Acceptance and Perception on Improved Tomato Varietal Attributes

Varieties	Ease of usage	Perceived usefulness	Affordability	Productivity	Resistance to pest and disease	Shelf life	Maturity days
UC82B	92.46	81.88	98.15	79.66	64.03	73.27	81.35
Riogrande	87.73	78.95	78.67	88.67	55.33	88.67	74.67
Chibli	64.37	81.78	43.75	92.50	57.50	98.13	77.5
Average decision values	**81.52**	**80.87**	**73.52**	**86.94**	**58.95**	**86.69**	**77.84**

Decision rule: if DV ≥ 40% Agreement, if DV ≤ 40% Disagreement.

Factors Influencing the Use of Improved Tomato Varieties

The UC82B improved tomato variety based on logit model result reported that among the eight (8) independent variables used in the model, for (4) variables were significant with respect to acceptance of UC82B improved tomato variety at 1%, 5% and 10% probability level (Table 3). These variables include age, gender, marital status, educational status, farm size, and access to credit which implies a unit increase of the variables leads to increase of the acceptance of UC82B variety. This is in harmony with the work of Abolusoro *et al.*, (2014).

Table 3 further showed the factors that influence the use of Riogrande improved tomato variety. The result revealed that gender (0.941), educational status (0.828), farming experience (0.069) and credit access (0.902) was found to be positively and significantly influenced the probability of accepting of the variety at 1%, 5% and 10% probability level. The result of logit regression presented in table 9 further revealed that farm size (-0.376) had a negative influence on the acceptance of the variety. The negative association suggests that the likelihood of accepting Riogrande improved variety declines as the farm size increases. The implication is that any increase in respect of variables with positive signs or decrease with respect to variables with negative signs could lead to increase or decrease in farmers opinion to accept or reject the variety and subsequently the output.

The Chibli improved tomato variety as revealed in Table 3 showed that the coefficient of the variable age (0.107 was found to be positively and significantly influenced the probability of accepting the variety at 1% probability level, meaning a unit increase of these variable would lead to the chance of accepting the variety. The findings of this study tallied with Josephine (2014) who reported that age is paramount in tomato Farmers' decision making. On the other hand, the increase of these variable with negative sign, i.e., gender (-0.998), educational status (-0.599), household size (-0.104), farming experience (-0.130) and credit access (-0.964) would lead non-acceptance of the variety.

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Table 3: Factors that Influenced Acceptance of Improved Tomato Varieties

Varieties	UC82B			Riogrande			Chibli		
Variables	**Coefficients**	**Std error**	**Sign**	**Coefficients**	**Std error**	**Sign**	**Coefficients**	**Std error**	**Sign**
Constant	-3.161	1.171	0.007*	-4.335	1.288	0.001**	0.007	1.364	0.996
Age	0.023	0.028	0.412	0.031	0.022	0.159	0.107	0.034	0.002**
Gender	0.962	0.387	0.013*	0.941	0.527	0.074*	-0.998	0.47	0.034**
Education status	0.528	0.183	0.004**	0.828	0.196	0.000**	-0.599	0.232	0.010*
Household size	0.077	0.046	0.091*	0.037	0.023	0.100*	-0.104	0.059	0.076*
Farm size	-0.475	0.419	0.258	-0.376	0.131	0.004**	0.182	0.578	0.753
Farming experience	-0.032	0.036	0.377	0.069	0.035	0.050*	-0.13	0.048	0.006*
Credit access	0.865	0.368	0.019*	0.902	0.382	0.018*	-0.964	0.465	0.038*
-2 Log likelihood	196.17			189.193			125.16		
Wald	17.33			17.328			60.77		
Cox and Snell R^2	18.3			21.3			18.3		
Negelkerke R^2	25.2			29.5			37.1		

Note: *significant at 10%; **significant at 5%

Constraint of Tomato Production

Constraints are any form of abnormalities which are capable of and can be able to decrease the quantity of output expected by a tomato farmer. The most mentioned problem that farmers encounter tomato production, as shown in Table 4 was price instability of tomato as reported by (72.90%) of tomato farmers. This may be as a result of price fluctuation resulted from the raw product availability changes during the season. The instability of prices implies that actors face difficulties in forecasting their revenue, leading to poor planning. However, the lack of knowledge or different ways of marketing, affects the marketing decision and production of the produce.

Table 4: Constraints of Tomato Farmers

Constraints	Frequency	Percentage	Ranking
Inadequate irrigated water	102	56.40	3rd
Problem of pests and diseases	114	63.00	2nd
Seasonal condition	58	32.00	6th
Inadequate inputs	60	44.80	4th
Instability of tomato prices	132	72.90	1st
Non availability of qualitative chemicals	81	33.10	5th

The inadequacy of a good marketing structure and marketing information is a major challenge that affects tomato farmers. This confirms the result of separate studies carried out by Sunusi and Dada (2009) and Ugonna *et al.* (2015) who reported that lack of markets as main problem that hinder tomato production in Ogun state and Nigeria in general. It was found from the result that problem of pest and disease is the second most pressing problem limiting tomato production as reported by 63% of the tomato farmers. This is because farmers do not have enough credits necessary chemicals that will control the pest. Also, farmers report that the chemicals were not good enough to control pest and disease evading their farm.

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CONCLUSION AND RECOMMENDATIONS

In conclusion, the socio-economic factors revealed that farmers in the study area were mostly male, relatively young and had experienced in farming business. The study reveals that farmers in the study area strongly preferred UC82B variety than any other variety. This study therefore comes to the conclusion that acceptance of new improved tomato varieties is conditioned by farmer perception and preferences. It was recommended in addition to the followings that the planning and implementation of the development of new varieties must therefore begin with in-depth study of farmer preferences before such varieties' adoption rates can be expected to increase;

1. The result shows that farmers attached greater importance on UC82B improved tomato variety, therefore, areas that have high prevalence of pest and disease would be recommended to use UC82B as it has high resistivity to pest coupled with its ease of use and short maturity days.
2. Also, areas that have less prevalence of pest and diseases could productively use Chibli as it also has high productivity and stronger shelf life compared with other improved tomato varieties.
3. Access to water and good irrigation infrastructure has been found to be important contributors to profitable tomato farming as majority of farmers indicated that they experienced water scarcity. There is need for investment in water infrastructure so that farmers can expand their production and reduce yield fluctuations.
4. Farmers should construct mud cooling chamber in their farms and store their tomato harvest as this will reduce loss and market glut.

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