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WILLINGNESS TO PAY FOR IRRIGATION TECHNOLOGY: THE ROLE OF PERCEIVED BENEFITS AND BARRIERS AMONG COHORT OF VEGETABLE FARMERS IN SOUTHWEST NIGERIA

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Abstract

Adopting irrigation technology in vegetable production is beyond just the ability to pay. It is a decision that involves the sociology of consumption which asserts the relevance of human perception. Hence, this study was designed to examine how the perceived- benefit of, and barrier against adoption of irrigation technology predict vegetable farmers' willingness to pay for irrigation technology in Ido LGA of Oyo State, Southwest Nigeria. A structured questionnaire was used to collect data from 110 respondents who were sampled using snowball method. Multi-item measures were used to assess variables. Significant differences in mean scores of willingness to pay across sub-groups of sex, age, education, economic wherewithal and category of technology-use were assessed using independent sample *Z*-test and one-way ANOVA. Stepwise, multiple linear regression was used to assess the predictors of willingness to pay. Results indicate that 30%, 18.2%, and 51.8% of respondents do not currently use irrigation technology, use basic, and improved technology for vegetable production respectively. Respondents who exhibited poor and high willingness to pay constituted 39.1% and 60.9% respectively. Sex, age, education and technology use have no significant effects on willingness to pay ($p > 0.05$), but economic wherewithal did ($p < 0.05$). Perceived barrier is a better predictor (standardized β= -0.592, R^2= 0.374, r= -0.611, $p < 0.001$) when compared to perceived benefit (standardized β= 0.220, R^2= 0.048, r= 0.273, $p < 0.05$). The two variables afforded multiple relationship of 64.9% and explained 42.2% of the variation in willingness to pay (multiple correlation= 0.649; R^2= 0.422, $p < 0.001$). Economic wherewithal is a fundamental limitation to willingness to adopt irrigation technology for vegetable production. Perceived barrier significantly decreased this willingness far more than perceived benefit expands same. Therefore, efforts directed at expanding the adoption of irrigation technology for vegetable production must focus more on boosting farmer-finances and mitigating barriers against the use of irrigation technology.

Keywords: Vegetable production, irrigation technology, perceived benefit, perceived barrier, willingness to pay

Introduction

Irrigation is an age-long, ingenious agricultural practice that allows the conveyance of water to where it is mostly required. It is a fundamentally significant practice enabling increased production of food for sustained food security. Two-fifth of global food production comes from one-fifth of irrigated land (Kadiresan and Khanal, 2018; Mpanga and Idowu, 2021). This underscores the inevitability of irrigation for productive agriculture and improved farming livelihoods. Moreover, evidence indicates a high reliance on irrigation in several climes. More than 80% and 70% of food production in Pakistan and China are on account of irrigated agriculture respectively (Kadiresan and Khanal, 2018). Yet, irrigation agriculture is poorly practiced in Nigeria. The situation in Nigeria showcases an abysmally low level of irrigation agriculture and a gross cause for concern. The report of the 2010/2011 Nigerian General Household Survey (GHS) shows that only 2.8% of plots held by farming households in Nigeria were irrigated (NBS, 2012). This percentage reduced in subsequent years to 1.6, 1.7 and 2.2 as reported in 2012/2013, 2015/16 and the 2018/19 GHS(s) respectively (NBS, 2014, 2016 and 2019). Still, poor irrigation is just one of the several limitations of agricultural performance in Nigeria. The (Nigerian agricultural) sector faces many challenges; notably an outdated land tenure system that constrains access to land (1.8ha/farming household), a very low level of irrigation development (less than 1% of cropped land under irrigation), limited adoption of research findings and technologies, high cost of farm inputs, poor access to credit, inefficient fertilizer procurement and distribution, inadequate storage facilities and poor access to markets have all combined to keep agricultural productivity low (average of 1.2mt of cereals/ha) with high postharvest losses and waste (FAO, 2020).

The need for agricultural productivity in Nigeria is salient in the light of the country's unique soaring population even in the sub-Saharan African region. Although Nigeria is expected to record the highest growth in population by 2050, Nigeria's currently huge population makes it inevitable for the country to contribute significantly to global population growth (Ibrahim and Arulogun, 2020). Nigeria is the second of nine nations that will account for 50% of world population growth between 2017 and 2050 (UN, 2017). Hence, farmers are under pressure directly or indirectly to improve food production. The challenges orchestrated by climate change further this pressure because this change has made food production to become more challenging (Stringer *et al*., 2020). Farming is the occupation that has suffered the most from climate change in Africa (Adimassu *et al*., 2014). Meagre technology use and poor financial wherewithal among farmers make reliance on rain-fed agriculture to be inevitable (Mulwa *et al*., 2017). Up to 95% of agricultural production in sub-Saharan Africa is dependent on rainfall (Okonya *et al*., 2013; Hassan and Nhemachena, 2008). The performance of agriculture in Nigeria and other countries south of the Sahara can certainly be better, and translate to improved livelihood of producers and food security of the nation(s).

Vegetable production is a unique and important aspect of agricultural production given its greater capacity to enhance the financial status of farmers (Ghimire *et al*., 2018; Rai *et al*, 2019). Using a small piece of land, vegetable production can yield a great return on investment over a little period (Gurung *et al*., 2016a; 2016b). Bamire and Oke (2004) and Adebisi-Adelani *et al*. (2011) also noted that growing vegetables is an essential income boosting activity which has grown in popularity in southwest Nigeria. Adopting irrigation technology for vegetable production stands to benefit profitability of production even further. For instance, the extent of irrigation was found to be positively and significantly ($p < 0.01$) related to output among vegetable producers in Lagos Nigeria (Obayelu *et al*., 2016). It is therefore important that vegetable farmers mitigate challenges confronting increased production in the interest of their sustained livelihood. Farmer's willingness to pay for irrigation technology is an orientation premised on self-determination rather than subscribing to a dependency regime that awaits government and other foreign aids to promote productivity (Ibrahim, 2019).

Although adoption or willingness to pay for any technology is an economic decision that primarily requires the ability to pay; this willingness is equally a socially dependent phenomenon. The sociology of consumption asserts the relevance of human perception, symbolic value and a host of other socio-culturally dependent phenomena (Warde, 2015; Fielding-Singh, 2017). Perceived benefits and barriers are exemplifications of socio-cultural and economic variables. Therefore, this study was designed to examine how the perceived- benefits and barriers against adoption of irrigation technology predict vegetable farmers' willingness to pay for irrigation technology in Ido Local Government Area (LGA) of Oyo State, southwest Nigeria. In addition, respondents' usage of irrigation technology, category of technology used and the amount of money respondents' are willing to pay, were examined. The effects of sex, age and education cum economic wherewithal, technology use on willingness to pay for irrigation technology were also examined.

Methodology

Study area

This study was undertaken at Ido LGA of Oyo State, Southwest Nigeria. The total land area of the LGA is 986km^2 (Aremu *et al*., 2015) and has a total population of 103,261 people (NPC, 2007). The population of the LGA was projected to be 146,200 as at 2016 (CPS, undated). The people of the LGA are typically small-scale farmers but most of them diversify their livelihood by engaging in other jobs like trading, artisanship, civil-service employment, hunting, etc. Farmers in the LGA are reputed for producing food crops including: maize, cassava, yam, and vegetables. Cash crops including: cocoa, kola and oil palm are also produced by farmers in the area (Omotayo and Oyekale, 2013). Yoruba people are dominant in the study area considering that Oyo State is one of the six states in the southwest region, the ancestral home of the Yoruba people. However, other ethnic nationalities such as Hausa, Igbo, Fulani, Igbira, reside in the study area.

Sampling procedure

Most of the farmers usually plant vegetables in addition to other food crops, but farmers who identify themselves mainly as vegetable producers were targeted for the study. There are ten wards in Ido LGA. They were identified, and four of same were randomly selected. They include: Ido, Omi-Adio, Akufo and Apete. All the communities/villages in the selected wards were identified. Further, two villages/communities were randomly selected from each ward. They are Idi-Igbaro, Omi-Adio, Akufo, Odufemi, Oloje, Bakatari, Olokiti and Odebode. The study took place in the eight communities. It is difficult to find the required sample size because it is difficult to estimate the population of the targeted audience, i.e. farmers who identify themselves as primarily/mainly engaged in vegetable farming. So, they were sampled through snowballing. On the whole, 110 respondents were sampled.

Data Collection

A structured questionnaire (with an open-ended question) administered via structured interview was used to collect primary data. A Yoruba version of the questionnaire was also prepared to aid consistent conversation with respondents who are not fluent in English language. Perceived benefits of adoption of irrigation technology (henceforth, perceived benefit) was operationally defined as respondents' evaluation of the advantages to be derived from using same. Perceived benefit was measured with a 5-item author-constructed Likert scale which was found to be reliable given its Cronbach's alpha score of 0.648. An example of items in the scale is "using irrigation technology will ultimately increase my income". Perceived barriers against adopting irrigation technology (henceforth, perceived barrier) was defined as the disadvantages involved in using same. It was also measured with a 5-item author-developed Likert scale whose Cronbach's alpha score was 0.748. An example of items in the scale is "people do not always speak well of irrigation technology for vegetable production". Willingness to pay for irrigation technology (henceforth, willingness to pay) was defined as the extent to which respondents are ready, and have no reason not to pay for irrigation technology for vegetable production. It was similarly assessed with a 5-item author-constructed scale. The Cronbach's alpha was 0.729. Response categories for all items include: "strongly agree (4)", "agree (3)", "disagree (2)" and "strongly disagree (1)". The possible total score ranged from 5 to 20 for each scale. Economic wherewithal was defined as respondents' subjective evaluation of their financial capacity. It was assessed with a single item asking respondents to describe their current financial capacity. Responses include: 'not enough, incurring debt'; 'not enough, without debt'; 'enough, without savings' and 'enough, with savings'. These responses are designated as very weak, weak, strong and very strong respectively. Socio-demographic characteristics including sex, age and education were assessed nominally. The amount of money respondents are willing to pay for irrigation technology was assessed with a single, open-ended question which required respondents to simply state such amount.

Data analyses

Simple percentile analysis was used to examine distribution of socio-demographic characteristics. A stacked bar chart was used to show the distribution of types of vegetables grown by respondents. Mean ±SD, minimum and maximum scores were used for the univariate analyses of perceived benefit, perceived barrier, willingness to pay and the amount respondents are willing to pay. Respondents' willingness to pay was categorized using the mean of the distribution. Deviation from normalcy of interval-level data was tested using the Kolmogorov Smirnov test. The effect of sex and age, education, economic wherewithal and technology use on willingness was tested using independent samples *Z*-test and One-way ANOVA respectively. The mathematical representation of the *Z*-test is presented thus

:

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{SP\sqrt{\frac{1}{n1}+\frac{1}{n2}}} \text{......1}$$

$$SP = \sqrt{\frac{(n1-1)s_1^2+(n2-1)n_2^2}{n1+n2-2}} \text{....... 2}$$

Where $\bar{x}_1$ = mean of first sample (men); $\bar{x}_2$ = mean of second sample (women); $n1$ = sample size (i.e., number of observations) of first sample; $n2$ = sample size (i.e., number of observations) of second sample; $s1$ = standard error of first sample; $s2$ = standard error of second sample; sp = pooled standard error. The mathematical representation of the one-way ANOVA is presented thus:

$$F = \frac{\sum n_j\,(\bar{X}_j - \bar{X})^2/(K-1)}{\sum\sum(X - \bar{X}_J)^2/(N-K)} \text{.....3}$$

Where n_j = the sample size in the j^{th} group(s). The j^{th} group(s) are the sub-groups of age, education, economic wherewithal and technology use. $\bar{X}$ = overall mean; $\bar{X}_j$ = sample mean in the j^{th} group, K = number of independent groups and N = total number of observations i.e. 110. Levene's test was used to examine the homogeneity of variance across sub-groups. R and R^2 were used to evaluate the extent of significant effects. Significantly different means were separated with post-hoc test, specifically the Tukey HSD procedure. Stepwise, multiple linear regression (using Multiple R and R^2) was used to assess the collective explanatory power of perceived benefit and perceived barrier. R^2 change, standardized β and zero-order correlation were employed to determine the lone contributions of perceived benefit and perceived barrier. The mathematical representation of the regression is expressed thus:

$Y = a + bX_1 + cX_2 + \epsilon$ 4

Where Y is the dependent variable, i.e. willingness to pay; a = intercept, b and c are slopes and ϵ is residual error, X_1 and X_2 are the independent variables, i.e. perceived benefit and perceived barrier. Data analyses were done using statistical package for the social sciences (SPSS, version 23.0).

Results and Discussion

Socio-demographic and economic characteristics of respondents

The distributions of respondents' socio-demographic and economic characteristics are presented in Table 2. Male respondents were about 59.1%, while their female counterparts were 40.9%. Women's population is quite competitive and close to men's. Many respondents (43.6%) were aged from 36 to 45 years, while the age range of 20.9% of respondents was 46 to 55. This is an indication of an active population of vegetable farmers in the study area. Respondents who had primary (35.5%) and secondary education (34.5%) were made up 70% of the study sample. about 14.5% of respondents had no formal education. Subjectively described economic wherewithal was strong among 68.2% of respondents. This is quite high. However, financial wherewithal was very weak and weak among 10.9% and 20.9% of respondents respectively. This is a noticeable limitation of vegetable farmers' financial well-being in the study area. The distribution of types of vegetables grown by respondents is represented in Figure 1, which is in the appendix.

Table 2: Socio-demographic and economic characteristics of respondents (N = 110)

Variable	Sub-groups	Frequency	Percentage
Sex	Male	65	59.1
	Female	45	40.9
Age	16-25	7	6.4
	26-35	29	26.4
	36-45	48	43.6
	46-55	23	20.9
	56-65	3	2.7
Education	No formal education	16	14.5
	Primary level	39	35.5
	Secondary level	38	34.5
	Tertiary education	16	14.5
	Adult education	1	0.9
Economic wherewithal*	Very weak	12	10.9
	Weak	23	20.9
	Strong	39	35.5
	Very strong	36	32.7

Very weak (not enough, incurring debt); weak (not enough, without debt); strong (enough, without savings) and very strong (enough, with savings)

Current use of irrigation technology among respondents

Table 3 shows that 70% of respondents currently use irrigation technology for vegetable production but 30% do not. Basic technology including watering can, bucket and bowl are used by 18.2% of the 70% who use technology. Improved technology including water pump, tank with hose, sprinkler is however used by 51.8% of the respondents. This distribution is an indication of the high usage of irrigation technology among vegetable farmers in the study area. This is in accordance with other findings: in their study among 142 small-holder urban vegetable farmers in Lagos State, Nigeria, Obayelu *et al*. (2016) reported that 18.3% used motorized pumps, while 81.7% used manual irrigation along with watering cans. De Witt *et al*. (2021) also reported that 83% of farmers in Central Breede River Valley, South Africa, adopted irrigation technology. The use of irrigation technology for vegetable production appears popular in the study area, though the proportion of non-users is noticeable thereby showcasing palpable limitation to the gains of irrigated vegetable production. Perhaps irrigation use for vegetable production is more pronounced than irrigation for general agricultural production.

Table 3: Distribution of respondents according to use of irrigation technology/category of technology used

Variables	Dimensions of variables	Frequency	Percent
Use of any irrigation technology	Yes	77	70
	No	33	30
Category of technology used	None	33	30
	Basic technology*	20	18.2
	Improved technology**	57	51.8

Basic technology included watering can, bucket, bowl **Improved technology included water pump, tank with hose, sprinkler

Univariate analysis of perceived benefit, perceived barrier and willingness to pay for irrigation technology among respondents

Table 4 shows that the mean±SD of perceived benefit is 18.15±1.08 (range = 14 to 20). This indicates that perceived benefit is very high among respondents. The standard deviation also indicates that convergence of respondents' perceived benefit is high. The mean±SD of perceived barrier is 12.15±3.30 (range = 6 to 18). Perceived barrier is not so high. The convergence of respondents' perceived barrier is lower when compared with perceived benefit. The Mean±SD of willingness to pay is 16.22±2.67 (range = 8 to 20). Willingness is also high and its standard deviation is similar to perceived barrier. Respondents who exhibited poor and high willingness to pay constituted 39.1% and 60.9% of respondents respectively. This shows the high level of willingness to pay among the majority of respondents and implies that the demand for irrigation technology is high. In their study among 100 commercial vegetable farmers in Kumasi, Ghana, Amponsah *et al*. (2016) similarly reported that 60% of respondents were willing to pay for reclaimed water for irrigation (rather than using untreated low-quality water). The mean±SD of the amount of money that respondents are willing to pay for irrigation technology is 57,854:55±18,801:15 (range = 25,000:00 to 100,000:00). This is fair enough and further indicates the high demand for irrigation technology among vegetable farmers in the study area.

Table 4: Univariate analysis of perceived benefit, perceived barrier, willingness to pay for irrigation technology among respondents and amount respondents are willing to pay

Variable	Mean±SD	Minimum	Maximum	Range of possible scores
Perceived benefit	18.15±1.08	14.00	20.00	5 to 20
Perceived barrier	12.15±3.30	6.00	18.00	5 to 20
Willingness to pay*	16.22±2.67	8.00	20.00	5 to 20
Amount respondents are willing to pay (in naira)**	57,854:55±18,801:15	25,000:00	100,000:00	-

When respondents were categorized into two (those who scored > mean versus those who scored mean and < mean), 43 (39.1%) and 67 (60.9%) respondents exhibited poor and high willingness to pay respectively. **There is a positive and significant relationship between the amount respondents are willing to pay and willingness to pay (Pearson'r =0.405, p = 0.000)

Effects of socio-demographic characteristics on willingness to pay for irrigation technology

Female respondents are more willing to pay (mean±SD= 16.55±2.80) when compared with their male counterparts (mean±SD= 15.98±2.56). Women's motivation to pay for irrigation technology is better than men's. However, this difference is not significant (p> 0.05). Therefore, sex has no significant effect on willingness to pay. Gender was also found not to be significant in farmer's adoption of irrigation, in an analysis of secondary data collected across 18 states in Nigeria (Ogunniyi *et al*., 2018). However, Amponsah *et al*. (2016) found sex to be a significant determinant of willingness to pay for reclaimed water for irrigation among vegetable farmers in Ghana. The youngest age category (16-25) was most willing to pay (mean±SD= 17.43±3.46), while the oldest age category (56-65) was least willing to pay (mean±SD= 12.33±2.87). This suggests that willingness to pay relates inversely with age. Mu *et al*. (2019) similarly reported an inverse significant relationship between age and willingness to pay for agricultural water in China. However, there are no significant differences in means across sub-groups of age (p> 0.05) in the current study. Age has no significant effect on willingness to pay. Ogunniyi *et al*. (2018) also found that age is not a significant determinant of adoption of irrigation. Respondents who had no formal education were most willing to pay (mean±SD= 17.31±1.89). Although willingness to pay is similar across all other sub-groups of education, those who have secondary education were least willing to pay (mean±SD= 15.68±3.04). However, means across sub-groups of education are not significantly different (p> 0.05). In contrast, education was found to be a significant determinant of willingness to pay for reclaimed water for irrigation among vegetable farmers in Ghana (Amponsah *et al*., 2016). Current findings show that education has no significant effect on willingness to pay. The results of the analyses of the effects of sex, age and education on willingness to pay is in table 5.

Table 5: Effect of sex, age and education on willingness to pay for irrigation technology

Socio-demographic variables	Sub-groups	Mean ±SD	Levene's test for homogeneity of variances		ANOVA		Z-test	
			Levene's statistic	*p*-value	F statistic	*p*-value	t statistic	*p*-value
Sex	Male	15.98±2.56	0.058	0.811	-	-	-1.105	0.271
	Female	16.55±2.80						
Age	16-25	17.43±3.46	0.097	0.983	2.058	0.092	-	-
	26-35	16.38±2.60						
	36-45	16.19±2.47						
	46-55	16.22±2.64						
	56-65	12.33±2.87						
Education*	No formal education	17.31±1.89	2.150	0.098	1.433	0.237	-	-
	Primary level	16.31±2.56						
	Secondary level	15.68±3.04						
	Tertiary education	16.12±2.58						

***The only respondent who had adult education was excluded from this analysis**

Effects of economic wherewithal and technology use on willingness to pay for irrigation technology

The results of the analyses of the effects of economic wherewithal and technology use on willingness to pay are shown in Table 6. Respondents' willingness to pay increased with increasing economic wherewithal: those exhibiting very strong economic capacity were most willing to pay (mean±SD= 17.44±2.09). On the other hand, those who were very weak economically were least willing to pay (mean±SD= 14.26±3.15). Means across subgroups of economic wherewithal were significantly different (p< 0.05). Hence, economic wherewithal has a main effect on willingness to pay. This is consistent with the dictates of basic economics. A study of production constraints among 73 vegetable farmers in Oyo State, Nigeria indicates that access to credit facilities (65.8%) and the problem of capital accumulation (52.1%) were the most frequently cited challenges (Adebisi-Adelani *et al*., 2011). Another study designed to analyze secondary data which captured 2,305 farming households across 18 States in Nigeria shows that access to credit was a significant determinant of adoption of irrigation (Ogunniyi *et al*., 2018). Vegetable farmer's net revenue per capita (a measure of wealth) was also found to be a significant factor affecting willingness to pay for reclaimed water in Ghana (Amponsah *et al*., 2016). These findings support the current findings and reinforces economic challenge as a fundamental limitation to mechanized agricultural production generally and vegetable production in particular. The effect of economic wherewithal on willingness to pay is linear ($p< 0.05$). R was 0.378 while R^2 was 0.143. Hence, 14.3% of the variance in willingness to pay is accounted by economic wherewithal. The result of post-hoc test indicates that the 'very weak' and the 'weak' sub-groups are significantly different from the 'strong' and 'very strong' sub-groups. Respondents who are currently not using any irrigation technology are least willing to pay (mean±SD= 15.76±3.14). This was closely followed by those who use basic technology (mean±SD= 16.00±2.94), while those who currently use improved technology exhibited the strongest willingness to pay (mean±SD= 16.56±2.24). This suggests the relevance of previous experience in people's willingness to pay. However, the means across sub-groups of technology use were not significantly different ($p> 0.05$). So, technology use has no significant effect on willingness to pay for irrigation technology.

Table 6: Economic wherewithal, technology use and willingness to pay for irrigation technology

Variables	Sub-groups	Mean ±SD	Levene's test for homogeneity of variances		ANOVA		R	R^2
			Levene's statistic	*p*-value	F statistic	*p*-value		
Economic wherewithal*	Very weak	14.26±3.15	1.300	0.278	8.679	0.000	0.378	0.143
	Weak	15.42±2.23						
	Strong	16.49±2.27						
	Very strong	17.44±2.09						
Technology use	None	15.76±3.14	1.986	0.142	1.032	0.360	-	-
	Basic technology	16.00±2.94						
	Improved technology	16.56±2.24						

The effect of economic wherewithal on willingness to pay is linear (F= 18.91, p = 0.000). Post hoc test (Tukey HSD) shows that the 'very weak' and the 'weak' sub-groups are significantly different from the 'strong' and 'very strong' sub-groups

Prediction of willingness to pay for irrigation technology by perceived- benefit and barrier

The results of multiple linear regression in Table 7 shows that perceived barrier is a significant predictor of willingness to pay (standardized $\beta = -0.592$, $p< 0.001$). For every 0.592 increase in perceived barrier, there is 1 unit decrease in willingness to pay. Further, perceived barrier yielded an R^2 change of 0.374 ($p <0.001$) for willingness to pay. The implication is that 37.4% of the variance in willingness to pay is accounted for by perceived barrier. Results further indicate that there is a significant and negative relationship ($r = -0.611$, $p <0.001$) between perceived barrier and willingness to pay. Hence, perceived barrier is a significant predictor and correlate, and provides a high account of willingness to pay. A report has shown that constraints of irrigated vegetable farming including irregular fuel supply (24.7%), pump breakdown (24.7%), inadequate technical know-how (16.4%) were cited in earlier study among vegetable farmers in Oyo State (Adebisi-Adelani *et al*., 2011). Perceived barrier is a significant and strong limitation to willingness to pay.

Results further indicate that perceived benefit is a significant predictor of willingness to pay (standardized $\beta = 0.220$, $p< 0.05$). For every 0.220 increase in perceived benefit, there is 1 unit increase in willingness to pay. Results also shows that perceived benefit yielded an R^2 change of 0.048 ($p <0.05$) for willingness to pay. The amount of variance in this willingness that is explained by perceived benefit is 4.8%. Table 7 also indicates that there is a significant, positive and fairly strong relationship ($r = 0.273$, $p <0.05$) between perceived benefit and willingness to pay. Hence, perceived benefit is a significant predictor/correlate, which provides a fair explanation of willingness to pay. Hence, increased perceived benefit is predisposes to increased willingness to pay for irrigation technology. In their study among 355 farmers, Charatsari *et al*. (2011) reported that perceived benefit explained 37.1% of the variance in farmers' willingness to pay for an agricultural educational program in Northern Greece. The multivariate analysis of willingness to pay on one hand and perceived barrier as well as perceived benefit on the other yielded a multiple R of 0.649 ($p<0.001$) and R^2 of 0.422 ($p < 0.001$). Hence, the two-variable model relates with willingness to pay by a degree of 64.9%, while it explains 42.2% of the variation in willingness to pay. The model provides significant and good explanation of willingness to pay. Perceived barrier is a much better predictor when compared with perceived benefits. The former strongly limits, while the latter fairly promotes willingness to pay.

Table 7: Result of step-wise multiple regression analysis of significant predictors of willingness to pay for irrigation technology

Model summary		Change statistics						
Multiple R	R^2	Predictors	R^2 Change	Standardized β	F statistic	*p* value (F change)	Zero-order correlation	*p* value (Zero-order correlation)
.649	.422	Perceived barrier	.374	-0.592	64.494	.000	-0.611	.000
		Perceived benefit	.048	0.220	8.868	.004	0.273	.004

Dependent variable: Willingness to pay for irrigation technology

Conclusion

The use of irrigation technology for vegetable production is predominant in the study area, and a high level of willingness to pay among majority of respondents. Willingness to pay is substantiated by the average amount of money that respondents are willing to pay for irrigation technology. Sex, age, education and current technology use are not significantly related to willingness to pay. Economic wherewithal is however significant for same, thereby reinforcing economic challenge as a fundamental limitation to mechanized agricultural production generally and vegetable production in particular. The stronger the perceived barrier, the lower the willingness to pay. Conversely, the stronger the perceived benefit, the higher the willingness to pay for irrigation technology. Barriers to use irrigation technology are much worthy of being focused in interventions intended for increased irrigated vegetable production.

References

Adebisi-Adelani, O., Olajide-Taiwo, F.B., Adeoye, I.B. and Olajide-Taiwo, L.O. (2011). Analysis of Production Constraints Facing Fadama Vegetable Farmers in Oyo State, Nigeria. *World Journal of Agricultural Sciences*, 7 (2): 189-192.

Adimassu, Z., Kessler, A. and Stroosnijder, L. (2014). Farmers Strategies to Perceived Trends of Rainfall and Crop Productivity in the Central Rift Valley of Ethiopia. *Environmental Development*, 11: 123–140.

Amponsah, O., Vigre, H., Braimah, I., Schou, T. W. and Abaidoo, R. C. (2016). The policy implications of urban open space commercial vegetable farmers' willingness and ability to pay for reclaimed water for irrigation in Kumasi, Ghana. *Heliyon*, 2(3), e00078. http://dx.doi.org/10.1016/j.heliyon.2016.e00078

Aremu, D.O., Ogunlowo Q.O., Azeez A.A., Babajide N.A. and Ogunlade C.A. (2015). Effectiveness and availability of packaging materials for fruits and vegetables: A case study of Ido local government, Ibadan, Oyo State, Nigeria. *Advances in Applied Science Research*, 6(6):125-128.

Bamire, A. S. and Oke, J. T. O. (2004). Profitability of vegetable farming under rainy-and dry-season production in Southwestern Nigeria. *Journal of Vegetable Crop Production*, 9(2): 11-18.

Charatsari, C., Papadaki-Klavdianou, A. and Michailidis, A. (2011). Farmers as consumers of agricultural education services: Willingness to pay and spend time. *The Journal of Agricultural Education and Extension*, 17(3): 253-266.

De Witt, M., De Clercq, W. P., Velazquez, F. J. B., Altobelli, F. and Marta, A. D. (2021). An in-depth evaluation of personal barriers to technology adoption in irrigated agriculture in South Africa. *Outlook on Agriculture*, 0030727020986941. https://doi.org/10.1177/0030727020986941

Fielding-Singh, P. (2017). A taste of inequality: Food's symbolic value across the socioeconomic spectrum. *Sociological Science*, 4: 424-448.

FAO (2020). Food and Agricultural Organization-Nigeria at Glance. Accessed 23/04/20 at *http://www.fao.org/nigeria/fao-innigeria/nigeria-at-a-glance/en/*

Ghimire, D., Lamsal, G., Paudel, B., Khatri, S. and Bhusal, B. (2018). Analysis of trend in area, production and yield of major vegetables of Nepal. *Trends in Horticulture*, 1(2): 1-11.

Gurung, B., Regmi, P. P., Thapa, R. B., Gautam, D. M., Gurung, G. M. and Karki, K. B. (2016a). Impact of PRISM Approach on Input Supply, Production and Produce Marketing of Commercial Vegetable Farming in Kaski and Kapilvastu District of Western Nepal. *Research and Review: Journal of Botanical Sciences*, 5: 34-43.

Gurung, B., Thapa, R. B., Gautam, D. M., Karki, K. B. and Regmi, P. P. (2016b). Commercial vegetable farming: An approach for poverty reduction in Nepal. *Agronomy Journal of Nepal*, 4: 92-106.

Hassan, R. and Nhemachena, C. (2008). Determinants of African Farmers' Strategies for Adapting to Climate Change: Multinomial Choice Analysis. *African Journal of Agricultural and Resource Economics*, 2(1): 83–104.

Ibrahim, F. M. and Arulogun, O. S. (2020). Posterity and population growth: fertility intention among a cohort of Nigerian adolescents. *Journal of Population Research*, 37(1): 25-52.

Ibrahim, F. M. (2019). Àgbẹ̀lọba: Optimism in Livelihood Dynamics among Yorùbá Farmers of Southwestern Nigeria. *Antropologija*, 19(2): 155-175.

Kadiresan, K. and Khanal, P. R. (2018). Rethinking irrigation for global food security. *Irrigation and drainage*, 67(1): 8-11.

Mpanga, I. K. and Idowu, O. J. (2021). A decade of irrigation water use trends in Southwest USA: The role of irrigation technology, best management practices, and outreach education programs. *Agricultural Water Management*, 243: 106438.

Mu, L., Wang, C., Xue, B., Wang, H. and Li, S. (2019). Assessing the impact of water price reform on farmers' willingness to pay for agricultural water in northwest China. *Journal of Cleaner Production*, 234: 1072-1081.

Mulwa, C., Marenya, P., Rahut, D.B. and Kassie, M. (2017). Response to Climate Risks among Smallholder Farmers in Malawi: A Multivariate Probit Assessment of the Role of Information, Household Demographics and Farm Characteristics. *Climate Risk Management*, 16: 208–221.

NPC (2007). National Population Commission. 2006 National Population Census. NPC Publication. Available at: www.nigerianstat.gov.ng. Accessed 9th June 2012.

NBS (2012). National Bureau of Statistics. Living Standard Measurement Study-Integrated Surveys on Agriculture: Nigeria General Household Survey Panel 2010/11 Wave 1. A Report by the National Bureau of Statistics in Collaboration with the Federal Ministry of Agriculture and Rural Development and the World Bank.

NBS (2014). National Bureau of Statistics. Living Standard Measurement Study-Integrated Surveys on Agriculture: Nigeria General Household Survey Panel 2012/13 Wave 2. A Report by the National Bureau of Statistics in Collaboration with the Federal Ministry of Agriculture and Rural Development and the World Bank.

NBS (2016). National Bureau of Statistics. Living Standard Measurement Study-Integrated Surveys on Agriculture: Nigeria General Household Survey Panel 2015/16 Wave 3. A Report by the National Bureau of Statistics in Collaboration with the Federal Ministry of Agriculture and Rural Development and the World Bank.

NBS (2019). National Bureau of Statistics. Living Standard Measurement Study-Integrated Surveys on Agriculture: Nigeria General Household Survey Panel 2018/19 Wave 4. A Survey Report by the National Bureau of Statistics in Collaboration with the World Bank.

Obayelu, O. A., Obayelu, A. E. and Usman, Z. A. (2016). Irrigation Technology and Technical and Resource-Use Efficiencies in Smallholder Urban Vegetable Farming. *International Journal of Vegetable Science*, 22(1): 91-100.

Ogunniyi, A., Omonona, B., Abioye, O. and Olagunju, K. (2018). Impact of irrigation technology use on crop yield, crop income and household food security in Nigeria: A treatment effect approach. *AIMS Agriculture and Food*, 3(2): 154–171.

Okonya, J.S., Syndikus, K. and Kroschel, J. (2013). Farmers' Perception of and Coping Strategies to Climate Change: Evidence from Six Agro-ecological Zones of Uganda. *Journal of Agricultural Science*, 5(8): 252.

Omotayo, A. O. and Oyekale, A. S. (2013). Effect of malaria on farming households' welfare in Ido local government area of Oyo state, Nigeria. *Journal of Human Ecology*, 44(2): 189-194.

Rai, M. K., Paudel, B., Zhang, Y., Khanal, N. R., Nepal, P. and Koirala, H. L. (2019). Vegetable farming and farmers' livelihood: Insights from Kathmandu Valley, Nepal. *Sustainability*, 11(3): 889. DOI::10.3390/su11030889

Stringer, L. C., Fraser, E. D., Harris, D., Lyon, C., Pereira, L., Ward, C. F. and Simelton, E. (2020). Adaptation and development pathways for different types of farmers. *Environmental Science & Policy*, 104: 174-189.

UN (2017). United Nations, Department of Economic and Social Affairs, Population Division. *World population prospects: The 2017 revision, key findings and advance tables*. Working Paper No. ESA/P/WP/248. https ://esa.un.org/unpd/wpp/Publi catio ns/Files /WPP20 17_KeyFi nding s.pdf. Accessed 8th July, 2017.

Warde, A. (2015). The Sociology of Consumption: Its Recent Development. *Annual Review of Sociology*, 41: 117–134.

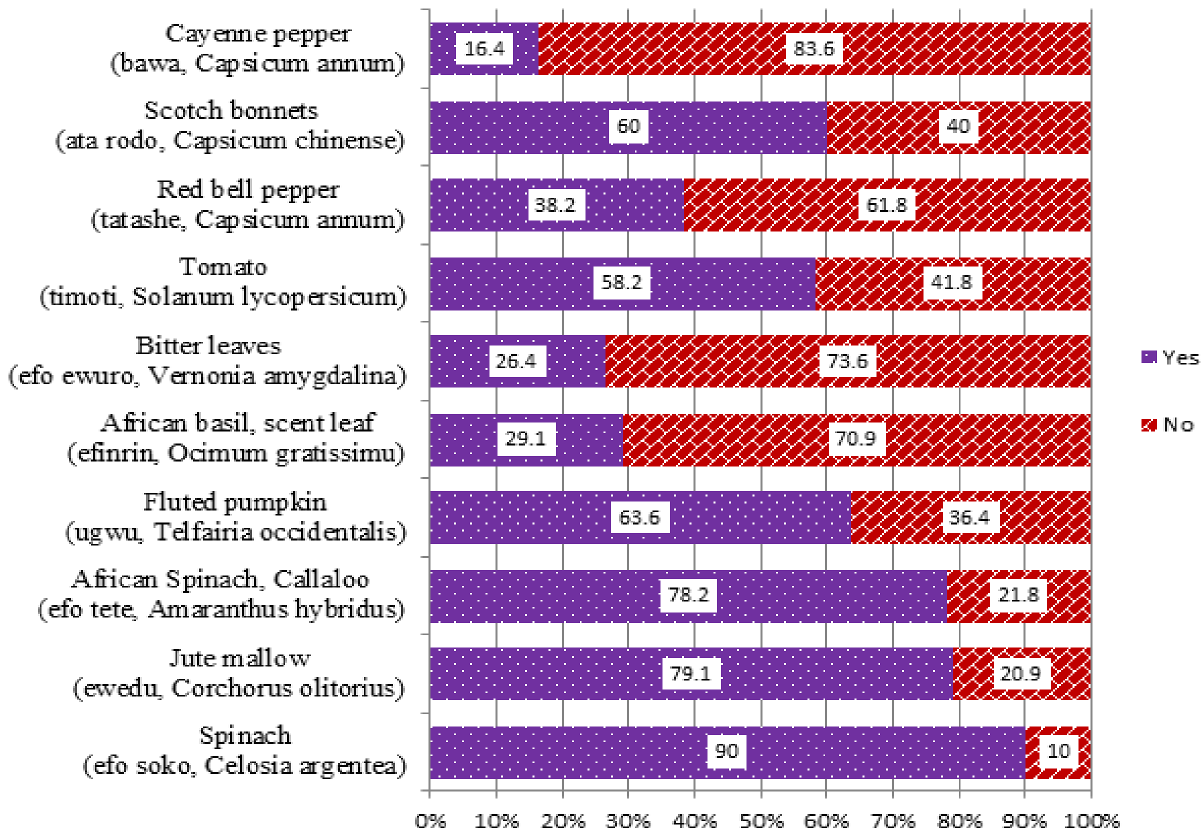

Figure 1: Stacked bar chart showing distribution of types of vegetables grown by respondents. The English names of the vegetables are provided, while the Yoruba and botanical names are in brackets