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Determinants of consumer knowledge, frequency of intake and attitudes on traditional African vegetables in Tanzania

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ABSTRACT
Consumers in sub-Saharan Africa derive a major portion of their diets from vegetables which have been found to play a significant role in human nutrition, especially as important sources of vitamins, essential minerals, dietary fiber, and various phytochemicals. However, the consumption of vegetables is still below the recommended level by WHO and FAO. This study examined the factors that influence the nutrition knowledge, frequency intake and attitudes of consumers towards Traditional African Vegetables (TAVs) consumption. Generalized poison and factor analysis were used for analysis. Data were collected from purposively selected 262 consumers in Tengeru, Embaseny and Bangata markets in Arumeru District, Tanzania. Results showed that years of schooling, age and nature of occupation influenced consumer's nutrition knowledge. Intake Frequency of TAVs was influenced by distance to the market, taboos, price of TAVs and consumers annual income. Factor analysis results indicated that taste, health, freshness and perception influenced consumption of TAVs. These findings imply that consumption of TAVs can be enhanced by educating consumers on the health benefits of TAVs. There is also need to train consumers on preparation and cooking techniques of preserving taste as well as promoting storage technologies which would preserve freshness and nutritional contents of TAVs.

Key words: Arumeru District, consumer attitude, frequency intake, nutrition knowledge, traditional African vegetables

RÉSUMÉ
Les consommateurs en Afrique au Sud du Sahara tirent une grande partie de leur alimentation en légumes, qui jouent un rôle important dans la nutrition humaine, en particulier comme sources importantes de vitamines, minéraux essentiels, fibres alimentaires et divers produits phyto-chimiques. Toutefois, la consommation de légumes est toujours en dessous du niveau recommandé par l'OMS et la FAO. Cette étude a examiné les facteurs qui influencent les connaissances nutritionnelles, la fréquence d'absorption et les attitudes des consommateurs vis-à-vis des légumes traditionnels africains (LTA). Des modèles généralisés de poisson et d'analyse factorielle ont été utilisés. Les données ont été collectées auprès de 262 consommateurs sélectionnés à dessein aux marchés de Tengeru, Embaseny et Bangata dans le district d'Arumeru, en Tanzanie. Les résultats ont montré que les années de scolarité, l'âge et la profession influencent les connaissances nutritionnelles du consommateur. La fréquence de consommation des LTAs est influencée par la distance au marché, les tabous, le prix et le revenu annuel des consommateurs. Les résultats d'analyse factorielle montrent que le goût, la

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santé, la fraîcheur et la perception influencent la consommation. Ces résultats impliquent que la consommation des LTAs peut être améliorée en éduquant les consommateurs sur leurs avantages pour la santé. Il est également nécessaire de former les consommateurs sur les techniques de préparation, de cuisson et de conservation du goût, ainsi que promouvoir des technologies de stockage qui facilitent la préservation de la fraîcheur et la valeur nutritionnelle des LTAs.

Mots-clés: District d'Arumeru, attitude des consommateurs, fréquence de consommation, connaissance nutritionnelle, légumes traditionnels africains

INTRODUCTION

Consumption of indigenous and traditional leafy vegetables as an important source of micronutrients has attracted a great deal of attention in the tropics (Chweya and Eyzaguirre, 1999). Often, they provide the consumers with most of the daily nutrient requirements especially vitamins (C, A, B1, B6, B9, E), essential minerals, dietary fiber, and various phytochemicals (Liu *et al.,* 2001). Traditional African vegetables (TAVs) such as amaranth, African nightshade and African eggplant contain more of these nutrients compared to global vegetables such as white cabbage (Weinberger and Msuya, 2004). They also have medicinal properties and form part of local health care systems (Etkin, 2006). They are especially important in small childrens' diets to ensure normal growth and intellectual development.

Vegetable consumption patterns have dramatically changed in Sub-Saharan Africa (SSA) as a result of urbanization (Van Rensburg *et al.,* 2007) and globalization which have been observed to be the central forces underlying current dietary shifts (Chopra *et al.,* 2002). For example, the role of TAVs in the food consumption patterns of households in SSA is highly variable and depends on factors such as poverty status, degree of urbanization, distance to fresh produce markets and time of year (Vorster *et al.,* 2002). TAVs form a significant source of food in both rural and urban areas of SSA. However, their consumption tends to be inversely proportional to household income (Vorster *et al.,* 2002). As a result, poor households in rural areas tend to use these types of leafy vegetables more than their wealthier counterparts in urban areas, because they lack the financial means to purchase exotic vegetables. Several studies have pointed out that consumption of TAVs has been generally declining over the years (Keller *et al.,* 2005; Abukutsa-Onyango, 2007; Masayi and Netondo, 2012). Further, Odhav *et al.* (2007) observed that decline in use of TAVs resulted in poor diets and increased incidences of nutritional deficiency disorders and diseases. Hence, more efforts are needed to increase consumers` intake due to the health and nutritive values of TAVs.

Problem Statement

In the African continent as a whole, production, trade and consumption of indigenous African leafy vegetables is expanding (Schippers, 2000; 2002; 2006). However, different, often opposing trends are quite noticeable. Vegetable consumption per capita in Africa has been reported by FAO (2009) to be below the minimum recommended intake of 200 gm per person per day. In Tanzania for example, vegetable consumption grew from 107 to 113 gm per capita per day (FAO, 1994) between the year 1993 and 2000. By 2007, vegetable consumption had reached 200 gms per day for some high income consumers (Keding *et al.,* 2007). However, for most medium and low-income consumers, vegetable consumption per capita per day is still low and below the recommended level. In contemporary South Africa, a decline in the consumption of these TAVs particularly those that are harvested from the wild or as weeds, in favor of exotic vegetables has been observed even in selected rural areas of the country. This situation has led to high prevalence of malnutrition, stunted growth and general poor health (Ojiewo *et al.,* 2010). IFPRI (2001) forecasts that there will be an 18 percent increase in the number of malnourished

children in Sub-Saharan Africa from the year 2001 to 2020. The decline in use of TAVs by consumers has resulted into poor diets and increased incidence of nutritional deficiency disorders and diseases (Odhav *et al.,* 2007).

For a long time just like in most other African countries, researchers and policy makers in Tanzania ignored TAVs, but during the past three decades this has changed. TAVs in Tanzania have increasingly received attention from researchers and at the policy level, and the value of these plants has been recognized. For example, in 2008 the Ministry of Agriculture (MoA) helped to establish the Horticultural Development Council of Tanzania (HODECT) whose main aim is to promote and coordinate the development of the horticultural sub-sector. The Tegeru Horticulture Research and Training Institute has been expanded and modernized in the last decade. One of its key mandates is to conduct research and train consumers on the various aspects of indigenous vegetables (TAVs).

Consumption of TAVs depends much upon the culture of the community in question (Maundu, 1997). Consumers' attitude and the extent of consumption appear to be associated with knowledge of TAVs. Though some consumers are aware of the benefits of TAVs, literature suggests that some have negative attitudes towards these vegetables. For example, Vorster *et al.* (2007) noted that positive perceptions of TAVs are more among older and rural consumers while negative perceptions are more common among younger and urban consumers. Hence the efforts of researchers and policy makers on TAVs tends to contrast sharply with the negative image TAVs have come to carry among these important potential groups of consumers in the society, who tend to associate their consumption with poverty and the past (Vorster *et al.,* 2002; Hart and Vorster, 2006). In Tanzania, youths avoid traditional vegetables perhaps due to lack of knowledge on their nutrition and health importance (Keller *et al.,* 2005). On the other hand, food habits and taboos influence intake of indigenous vegetables demonstrating that, consumption of these vegetables depend on socio-economic characteristics (Yang and Keding, 2009). There is need therefore to understand the factors that are responsible for low consumption of nutrient-dense vegetables in Tanzania, particularly among township consumers.

Research Methodology

Theoretical Framework. Utility maximization is applied to the analysis of traditional African vegetables consumption following theoretical framework of count data models. Utility for TAVs is assumed to follow demand-oriented modeling approaches just like for exotic vegetables. They draw on the micro-economic theory of consumer behavior and consider the consumers' budget within which TAVs are purchased as fixed. The demand for TAVs is modelled using frequency of consumption. Jörgen (2002) observed that count data modeling techniques have become important tools in empirical studies of economic behavior and their applicability continues to grow in various areas of economics. Economic studies usually begin with a specification of a theoretical model trying to explain agent's (e.g. household, firm, individual) behavior or choice as depending on other variables (Jörgen, 2002). From the theoretical model, an empirically feasible regression model is formulated. The regression model is an empirical counterpart to the theoretical model where the choice or outcome on the variable of interest, is explained by explanatory variables specified by theory. In count data regression, the main focus is the effect of covariates on the frequency of an event, measured by non-negative and integer-valued counts (Jörgen, 2002). Models with count dependent variables are usually analyzed using count data models. Count variable models are typically analyzed using either Standard Poisson, Generalized Poisson Regression (GPR) or Negative Binomial Regression (Kirui, 2011). However, when data precludes zero responses, like in the current case, the strict application of Standard Poisson and negative binomial regression is inappropriate (Hilbe, 2011). Hence Generalized Poisson Regression (GPR) model is recommended for analytical estimation. This study therefore determined the factors influencing nutrition knowledge and frequency intake of TAVs by using

Generalized Poisson Regression model.

Consul and Famoye (1992) have presented an excellent overview of the basic generalized Poisson regression model and derivation. The probability distribution function of generalized Poisson distribution is defined as:

$$f(y;\lambda,\theta) = \theta(\theta+\lambda_i^{y_i})^{y_i}\frac{exp(-\theta-\lambda_i^{y_i})}{y_i!} \qquad (1)$$

Consul and Famoye (1992) and Hilbe (2011) show that the log-likelihood (LL) transformation for the above generalized Poisson probability distribution is given by:

$$y) = \sum_{i=1}^{n}\left\{y_i ln\left(\frac{\mu_i}{1+\alpha\mu_i}\right) + (y_i-1)ln(1+\alpha y_i) - \left[\frac{-\mu_i(1+\alpha y_i)}{1+\alpha\mu_i}\right] - ln\Gamma(y_i+1)\right\} \qquad (2)$$

Or in terms of xβ as

$$\mathcal{L}(\beta,\alpha;y) = \sum_{i=1}^{n}\left\{y_i ln\left(\frac{exp(x_i'\beta)}{1+\alpha exp(x_i')}\right) + (y_i-1)ln(1+\alpha y_i) - \left[\frac{exp(x_i'\beta)(1+\alpha y_i)}{1+\alpha exp(x_i'\beta)}\right] - ln\Gamma(y_1+1)\right\} \qquad (3)$$

Where: y_i= random response variable corresponding to the number of nutrition knowledge known to respondent (i)

x =covariate vectors of explanatory variables

β= linear predictor of random response variable

Model Specification: Factors affecting TAV nutrition knowledge. This study adopted five scale levels designed by Parmenter and Wardle (1999) in order to assess the level of nutrition knowledge related to TAVs, i.e., i) understanding of nutrition terms, ii) awareness of dietary recommendations, iii) knowledge of foods as source of nutrients, iv) ability to apply information on choices, and v) awareness of diet-disease associations. Urban consumers were asked whether or not they knew each of the nutrition scales and their implications. The total number of nutrition knowledge scales were then tallied depending on the responses for each case interviewed. The dependent variable was therefore the number of nutrition knowledge scales the consumer indicated she/he was aware of and had an understanding of its implication. Hence the expected response ranged from zero to five. Some respondents indicated that they have no awareness of the nutrition knowledge scales, and hence, there were zero responses. Few consumers indicated that they knew the five identified nutrition knowledge scales. Ultimately, the implicit functional form of the generalized Poisson regression model estimated was:

Scales of knowledge in nutrition known (y) = f (lnage, gender, education, lnincome, work status, type of occupation, social capital) + e (4)

Model Specification: Factors influencing the frequency of TAV intake. This study specified the dependent variable as the average number of times TAVs were consumed by the household per week in the process of assessing the factors influencing the frequency of intake of nutrient-dense vegetables. Hence the dependent variable for the frequency of intake was a number such as 0 times a week, 2 times a week etc. Ultimately, the approach used the Standard Poisson and Generalized Poisson Regression model to isolate the determinants of the frequency of intake because the dependent variable is a count data variable. Hence the estimated model was specified as:

Frequency of TAV intake (Z) = f (lnage, gender of consumers head, consumers size, lnincome, occupation, lnfsize, education, distance to market, price) + e (5)

Consumers' attitudes towards traditional African vegetables. Factor analysis was used to identify latent dimensions underlying the different variables that measured various attributes preferred by consumers. Responses to five-point Likert-type scale items was subjected to a principal component factor analysis (PCA) with Varimax rotation. The factors were subjected to the Kaiser-Meyer-Olkin and Bartlett's test (KMO and Bartlett's test) to determine the sampling adequacy. According to Leech *et al.* (2012), a KMO measure greater than 0.7 is preferable and is inadequate if it is less than 0.5. KMO test tells us whether or not enough items are predicted by each factor.

Data and variables. This study used data collected from consumers in Tengeru, Embaseny and Bangata markets in Arumeru District, Tanzania. These are the main TAVs markets within the District where the VINESA-AVRDC project is being implemented. The District is composed of three major ethnic groups i.e. Wameru, Waarusha and the pastoralist Maasai. The study was undertaken for about five months from July to November 2015. A cross-sectional survey of TAV consumers was carried out in the three horticulture markets. Purposive sampling technique was used to select consumers due to unavailability of records in the market offices. A structured questionnaire was administered to respondents through face-to-face interviews. The number of consumers selected and interviewed were 160 in Tengeru market, 77 in Embaseny market and 25 in Bangata market. This made a total of 262 TAV consumer cases who participated in the analysis. The variables used in this study were then extracted from the questionnaires administered to consumers as shown in Table 1.

RESULTS AND DISCUSSION

Descriptive statistics results. Table 2 shows the socioeconomic statistics of the study. The survey results demonstrated that the majority of the consumers' interviewed (26%) were males and 74% were females. Also 75% of the consumers had primary school education while only a few had middle-level college (0.76%) and university (1.14%) education for those who consumed TAVs. The observed results indicate that the educated population consume TAVs minimally. The mean age of the consumers was 39.65 years implying that youthful consumers of TAVs were relatively few. Hence there is need to promote consumption of TAVs among the youth. This trend raises a concern that if the youth and the educated groups are not consuming TAVs there is a likelihood of increased poor diets and incidences of nutritional deficiency disorders and diseases in the township areas. Farming is the main occupation for 62.6% of the consumers. However, no portion of the farming land is put under TAVs. Of the respondents 45%, 21% and 20% of the consumers were from Meru, Chagga and Arusha ethnic groups, respectively. The mean yearly income for consumers was Tshs 1,411,663 (approximately US$ 621.13).The results further showed that consumers spent Tshs 6,328. 63 (US$ 2.78) per week to purchase (TAVs). The frequency for household intake on a weekly basis was 1.2 times per week, i.e., basically once a week.

Factors affecting TAV nutrition knowledge for consumers. Nutrition knowledge was counted with the range of zero to five. Consumers were asked five questions to assess their knowledge in nutrition and scores from each case was added together. The results showed that the mean nutrition knowledge for consumers was 2.78 out of 5 (i.e. 55.6%) (Table 2). Hence consumers had moderate awareness of TAV nutrition knowledge.

Table 1. Description and expected sign of variables included in the Nutrition knowledge and Frequency Intake Models

Variable Name	Variable name	Variable coding	Expectations: Nutrition knowledge, Frequency intake- sign	Nutrition knowledge-sign	Frequency Intake Models
Gender	Gender of household head	1 if male, 0 if female	Men are expected to be generally more knowledgeable of their environment than women	+	+
Years of schooling	Number of years spent in school	Natural logarithm of number of years of school	The more the education the more the nutrition knowledge and frequency intake	+	+
Age	Age of the household head	Natural logarithm of age in years	One is expected to accrue more nutrition knowledge with age and increase intake	+	+
Occupation	Consumer's regular work or profession	1 if nutritionist, exposed to agricultural training, teacher, 0 otherwise	Consumers who are nutritionists or exposed to agricultural training are expected to have more nutrition knowledge and intake	+	

Income	Annual household income	Natural logarithm of income	The more the income the more the nutrition knowledge and intake	+	+
Group membership	Consumer is a member of a group	1 if yea, 0 otherwise	Consumers with membership in groups are expected to have more nutrition knowledge and intake	+	+
Household size	Number of members in a household	Natural logarithm of the size of household	The more the number of members in a household, the higher the nutrition knowledge and intake	+	+
TAVs farm size	Number of acres put under TAVs	Number of acres under TAVs	The bigger the area under TAVs the greater the likelihood of the consumer seeking for nutrition knowledge to increase intake	+	+
Distance to market	Number of minutes to the nearest market	Natural logarithm of number of minutes	The more the time taken to the market the less the frequency of intake		-
Culture/Taboos	Influence of culture/taboo on consumption	1 if yes, 0 if no	If culture influences consumption of TAVs at the household, the lower the frequency of intake		-
Medicinal value	Medicinal value influence intake	1 if yes, 0 otherwise	The more the attachment to medicinal properties of TAVs, the higher the intake		+
Price of TAVs	Price of TAVs affect frequency of intake	1 if yes, 0 otherwise	If TAVs prices are perceived to be high, the less the frequency intake		-
TAVs weekly expenditure	Amount spend weekly to purchase TAVs	Natural logarithm of expenditure	The higher the weekly expenditures on TAVs the lower the frequency of intake		+

Table 2. Socio-economic characteristics of the consumer sample

Demographic properties	Consumer (262)
Gender (%)	
Female	73.66
Male	26.34
Level of education (%)	
Number of years of schooling (mean)	6.95
None	8.78
Primary	75.57
Secondary	13.74
Middle-level college	0.76
University	1.14
Marital status of respondent (%)	
Married	81.68
Single	13.36
Separated	0.76
Divorced	0.76
Widow or widower	3.44
Age of respondent (mean)	39.65
Household size (count) mean	3.923
TAVs Farm size (acres) mean	-
Knowledge of nutrition (count) mean	2.755
Ethnicity group (%)	
Meru	45.42
Maasai	3.05
Arusha	20.23
Chagga	20.61
Others (Sukuma, Nyakyusa, Iraqw, Pare)	10.69
Main occupation (%)	
Agriculture	62.60
Casual labor	3.06
Formal employment	14.50
Business	7.25
Agriculture and livestock	12.60
Household income (Tshs) (mean)	1,411,663
Amount spent to purchase TAVs per week (Tshs) (mean)	6,328.63
Years in TAVs business (mean)	-
Distance to nearest market (mints) mean	28.393
Frequency intake (count) mean	1.214

Source: Author' survey of TAVs consumers in Arumeru District, July to November 2015

In order to examine the factors influencing nutrition knowledge among TAV consumers, models for count data that take the number of nutrition knowledge scale as dependent variable was used to fit a standard Poisson Regression model and Generalized Poisson Regression Model. The results of the fitted regression models are shown in Table 3. The Prob-chi^2 test statistic shows that both models fitted the data well (p-value = 0.0167 and 0.0062 respectively). The mean deviance and the Pearson chi-square ratio (the Pearson chi-square value divided by its degrees of freedom) were used to assess the goodness of fit of the standard Poisson model. The estimated Deviance and Pearson ratios are shown below:
Deviance/df = 123.8073647/231 = 0.5359626
Pearson/df = 107.9043492/231 = 0.4671184

These results showed that both ratios are significantly smaller than 1 indicating that there is evidence of under-dispersion. Hence the standard Poisson model does not fit the data well. Table 4 shows the results of Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) tests of goodness of fit for the two models. Lower values of either Akaike Information Criterion (AIC) or Bayesian Information Criterion (BIC) indicate a better fit. The results showed that generalized Poisson model was a better fit for the data. Consequently, the discussion below is based on the results of the Generalized Poisson model.

Years of schooling significantly (P-value<0.01) influenced nutrition knowledge of consumers. The more the number of the years spent in school by the respondent the more likely that the consumer will possess higher levels of nutrition knowledge. This showed that education plays an important role in sourcing and accessing nutrition knowledge. The less educated consumers are likely to be associated with less nutrition knowledge. This implies that less educated consumers most likely are not well informed of the benefits they could possibly accrue from possessing nutrition knowledge for TAVs. Each additional year a respondent spends in school was associated with an estimated 37% increase in nutrition knowledge. This shows that education plays an important role on knowledge in nutrition.

Table 3. Factors which influence consumers' knowledge in nutrition

	Standard Poisson		Generalized Poisson	
Dependent variable = Number of Nutrition knowledge known	IRR	P-values	IRR	P-values
Gender	1.039	0.543	1.041	0.460
Log of Years of schooling	1.414	0.002***	1.365	0.002**
Log of Age	1.239	0.261	1.276	0.064*
Log of Household size	1.041	0.648	1.03	0.726
Occupation	1.011	0.462	1.020	0.081*
Log of Income	1.004	0.902	0.994	0.825
Group membership	1.083	0.134	1.065	0.189
Constant	0.805	0.738	0.944	0.916
Number of observations	239	239		
Wald chi2(10)	17.11	19.73		
Prob>chi2	0.0167		0.0062	
Pseudo R2	0.0072		0.0184	

*, ** and *** denote significance level at 10, 5 and 1 percent, respectively

Table 4. Akaike's and Bayesian Information Criteria

Model	Obs.	ll(null) l	l(model)	df	AIC	BIC
Standard Poisson	239	-402.2397	-399.3466	8	814.6933	842.505
Generalized Poisson	239	-372.4379	-365.601	9	749.202	780.4902

Age of the respondent significantly influenced (P-value <0.1) knowledge in nutrition. This implied that each additional year of age to the consumer increased the expected knowledge in nutrition by some 27.6%. This implied that older TAVs' consumers were more knowledgeable in nutrition than younger consumers. Occupation of the respondent significantly (P-value<0.1) influenced knowledge in nutrition. Respondent`s occupation increased the number of expected nutrition knowledge by some 2%. This implied that consumers who had occupation were associated with increased knowledge in nutrition.

This study had hypothesized that education and income of the household jointly have no effect on the levels of nutrition knowledge among consumers. The results of Wald test (combined effect of education and income) however found that education and income have a joint statistically significant effect on the nutrition knowledge. The joint test yielded a p-value of 0.0069. The null hypothesis that education and income jointly do not influence knowledge in nutrition was therefore rejected at 0.01% level of significance. Overall, the model results showed that nutrition knowledge of consumers was positively influenced by the number of years of schooling, age of the respondent and occupation.

Factors affecting the frequency of TAV intake. In order to examine the factors influencing the frequency of TAV intake by consumers, models for count data that take the number of times a household consumes TAVs per week as a dependent variable was used to fit a Standard Poisson Regression model and Generalized Poisson Regression model. The results of the fitted regression models are shown in Table 5. The Prob-chi^2 test statistic showed that both the models fitted the data well (p-value = 0.0000 and 0.0000, respectively). The mean deviance and the Pearson chi-square ratio (the Pearson chi-square value divided by its degrees of freedom) were used to assess the degree of fit of the Standard Poisson model. The estimated Deviance and Pearson ratios are shown below:

Deviance/df = 58.08657017/227 = 0.255888
Pearson/df = 48.33728332/227 = 0.2129396

These results showed that both ratios are significantly smaller than 1 indicating that there is evidence of under-dispersion. Hence the Standard Poisson model does not fit the data well. Table 6 shows the results of Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) tests of goodness of fit for the two models. Lower values of either Akaike Information Criterion (AIC) or Bayesian Information Criterion (BIC) indicate a better fit. The results showed that Generalized Poisson model was a better fit for the data. Hence, the discussion below is based on the results of the Generalized Poisson model.

One of the factors influencing TAV consumption is distance to the market. This variable negatively and significantly (P-value<0.05) influenced frequency intake of TAVs. A reduction of the distance to the market causes the incidence rate ratio for frequency of TAVs to increase by a factor of 0.929, while holding all other variables in the model constant. This implies that an increase of time taken going to the market by one minute will decrease frequency intake of TAVs by approximately 7.1%.

The amount spent weekly to purchase TAVs positively influenced (P-value<0.001) the frequency intake of TAVs. This means that each additional one Tshs(Tanzanian currency) in the purchase of TAVs was associated with an estimated

Table 5. Factors which influence consumers' frequency intake

Dependent variable = Frequency intake	Standard Poisson		Generalized Poisson	
	IRR	P-values	IRR	P-values
Gender	1.057	0.349	1.100	0.154
Log of years in schooling	1.180	0.211	1.179	0.226
Log of age	1.079	0.356	1.156	0.123
Occupation	0.986	0.356	0.977	0.159
Log of income	1.021	0.544	1.028	0.439
Log of household size	1.054	0.513	1.092	0.369
Log of distance to Mkt	-0.932	0.038**	-0.929	0.012**
Culture/taboos	- 0.884	0.000***	-0.746	0.047**
Medicinal value	1.018	0.786	1.080	0.276
Price of TAVs	1.191	0.002***	1.213	0.002***
Log of TAVs weekly spent	1.156	0.000***	1.177	0.000***
Constant	0.139	0.006	0.064	0.001
Number of observations	239	239		
Wald chi^2 (11)	56.37		73.85	
Prob>chi^2	0.0000		0.0000	
Pseudo R^2	0.0161		0.1154	

*, ** and *** denote significance level at 10, 5 and 1 percent, respectively

Table 6. Akaike's and Bayesian Information Criterion

Model	Obs.	ll(null)	ll(model)	Df	AIC	BIC
Standard Poisson	239	-279.6684	-275.1778	12	574.3556	616.0731
Generalized Poisson	239	-234.7561	-207.6537	13	441.3073	486.5014

18% increase of the frequency intake. More money resources set aside to buy TAVs is an indication for increasing the frequency intake. The results also showed that the price of TAVs (P-value<0.01) positively influenced frequency intake of TAVs. The price of TAVs is generally lower than that of exotic vegetables and is usually affordable to consumers. The results showed that an increase in the price by one Tshs. would still result in increased consumption of TAVs by 21%. Culture/ taboos negatively and significantly (P-value<0.05) influenced the frequency of intake of TAVs by the consumers. Culture/ taboos decrease frequently intake of TAVs by some 25%. This implies that the more respondents maintain their culture and food taboos the less the consumption of TAVs.

The study had hypothesized that age and annual income of the household jointly had no effect on the frequency intake of TAVs. The results of Wald test (combined effect of age of the respondent and annual household income) however found that age of the respondent and household income had a joint statistically significant (p-value<0.05) effect on the frequency intake of TAVs. The null hypothesis was therefore rejected at 5% level of significance.

Consumers' attitudes towards consumption of traditional African vegetables. The study utilized factor analysis to assess consumers' attitude towards consumption of TAVs. Factor analysis was used to identify latent dimensions underlying the different variables that measured respondents' attitudes. Responses to the 11 five-point Likert-type scale items were subjected to principal component factor analysis. Factor analysis was selected to create measurement scales. In order to develop these scales, exploratory factor analysis with Varimax rotation was employed.

The objective was to obtain fewer dimensions that reflected the relationships among these inter-related variables. An Eigen-value greater than one rule was applied in identifying the number of factors. The variables that had large loadings on the same factors were grouped together. Factor loadings value of 0.50 and above is normally considered good and significant (George and Mallery, 2003). The analysis produced a solution with four factors that accounted for 58.22% of the total explained variance as shown in Table 7. The Kaiser's overall measure of sampling adequacy obtained was 0.667, which adequately borders on the recommended threshold of 0.7 suggesting that the data was marginally appropriate for factor analysis. Four attitude variables concerning taste of TAVs varieties was loaded on factor 1 with the cross-correlation coefficients of 0.460, 0.514, 0.790 and 0.783, respectively. This factor was termed 'Taste' of TAVs varieties because these variables involved taste of TAVs by local consumers, and also taste loads higher in this factor compared to other statements. Higher scores and positive responses on this factor revealed a general opinion that it was important to consider how TAVs varieties taste.

The second factor was "health" which had cross-correlation coefficients of 0.740, 0.772, and 0.410 respectively. These statements focused mainly on health values. This factor account for 15.31% of the total variance. Consumers are persuaded that TAVs have medicinal properties and hence are important for human health. In the study area, African eggplant has been used as treatment for blood pressure, African nightshade for increasing blood and jute mallow was used for stomach ulcers as well as cure for joints pains. "Freshness" was the third factor which had three attributes loaded and had cross-correlation coefficients of 0.640, 0.646 and 0.450, respectively. These attributes focused on the importance of consuming fresh TAVs. This factor accounted for 14.36% of the total variance.

The fourth factor "perception" had cross correlation coefficient of 0.899. This statement was labelled 'Perception' and accounted for 10.0% of the total variance. There is a negative perception towards TAVs particularly associated with men that these vegetables are not good for them. This has been the perception in the communities for years. Negative perceptions toward TAVs hinder their consumption. The cumulative percent of variance for all the four factors (Taste, Health, Freshness, and Perception) explained was 58.22%.

Table 7. Results of exploratory factor analysis

Factor and item description	Factor loading	% variance explained
Factor 1: Taste		18.55
TAVs are inferior foods (poverty food)	0.460	
It is important to choose diet accompanied with TAVs	0.514	
TAVs are tasteless and bitter	0.790	
I am willing to preserve TAVs for the next generation	0.783	
Factor 2: Health		15.31
Consumption of TAVs is important to women, children and men	0.740	
Consumption of TAVs improves eyesight and boosts immunity	0.772	
TAVs takes more time to prepare	0.410	
Factor 3: Freshness		14.36
TAVs are best consumed when fresh	0.640	
Fresh TAVs contain more nutrients than dried ones	0.646	
Eating a variety of TAVs each day guarantee vitamins	0.450	
Factor 4: Perception		10.00
TAVs are not good to me	0.899	
Total explained variance (%)		58.22

Source: Author' survey of TAVs consumers in Arumeru District, July to November 2015

CONCLUSIONS AND RECOMMENDATIONS

The purpose for this study was to determine the factors influencing consumers' nutrition knowledge, frequency of intake and the attitudes towards TAV consumption. Regression models were used to assess the factors influencing nutrition knowledge and frequency of TAVs intake by consumers. The standard poison model and generalized Poisson model were used to assess the factors determining nutrition knowledge and frequency of intake. The two aspects followed count data models. The study also used factor analysis to assess the attitudes of consumers on TAV consumption. The data used were collected through personal interviews using pretested questionnaires from 262 consumers in Tengeru, Embaseny and Bangata markets of the Arumeru District where the VINESA-AVRDC project was being implemented. The study cases were purposively selected to represent TAV consumers in the three Townships of the District.

The study found that the factors explaining the nutrition knowledge of consumers included number of years spent in school, age of the respondent and nature of occupation. The null hypothesis that education and income jointly do not influence nutrition knowledge of consumers was rejected. Consumer's frequency intake of TAVs was negatively influenced by distance to the market and culture/taboos. Price of TAVs and annual income also influenced frequency intake of TAVs. The null hypothesis that the age of the consumers and income jointly do not influence frequency intake of TAVs was rejected. The study concluded that socioeconomic factors have a significant effect on nutrition knowledge and frequency of intake of TAVs.

The attitude of consumers towards consumption of TAVs was mostly positive. This was shown by the finding that "taste" factor had the highest loading in the factor analysis. The "health" factor had the second highest loading. Hence there is need to explain medicinal value of these vegetables to a larger population. Fresh TAVs were more preferred than the dry ones. Improving preparation and cooking techniques of these vegetables would maintain their taste and nutrient content. The findings also showed that the perception factor loading was relatively high. This implied that a change of attitude is important because TAVs play an important role in human health. To enhance increased intake of nutrient-dense vegetables (TAVs), innovative ways of mixing various TAV' varieties during preparation could improve taste. Health attributes of TAVs should be incorporated in consumption promotional campaigns. Various promotional approaches such as posters, road shows and cooking demonstrations can be used. There is also need to promote storage technologies which would preserve freshness as well as nutritional contents of TAVs.

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STATEMENT OF NO-CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this paper.

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