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Research Application Summary

Preferences of consumers and their willingness to pay for cowpea variety traits: implications for breeding in Techiman Municipality, Ghana.

Mbroh, I.[1], Dadzie, S.K.N. [1], Coffie, O. R. [1], & Afutu, E.[2]

[1]Department of Agricultural Economics and Extension, School of Agriculture, College of Agriculture and Natural Sciences, University of Cape Coast, Cape Coast, Ghana
[2]Department of Crop Science, School of Agriculture, College of Agriculture and Natural Sciences, University of Cape Coast, Cape Coast, Ghana
***Corresponding author:** mbroh.isaac@stu.ucc.edu.gh or mbro.ike@gmail.com

Abstract

Cowpea is consumed in almost every home in Ghana and it provides the cheapest protein supplement to the urban and rural poor in Ghana. In order to design sustainable crop improvement programmes, consumers' preferred traits of cowpea need to be integrated into the breeding objectives. This study sought to examine the Ghanaian consumers' decision-making behaviour towards cowpea variety selection and the values they place on different traits of cowpea. The study was conducted in the Techiman Municipality of the Bono East Region of Ghana using a combination of purposive, random and accidental sampling methods in selecting the district, communities, and consumers. The target population was all cowpea consumers in the Municipality. Using a structured interview schedule with choice cards, face-to-face interviews and choice experiment were conducted to collect data from the target respondents. Finally, trait preferences were analyzed using the Mixed Logit (ML) model. The findings indicate that the consumers prefer cowpea with longer storage periods, white grain colour and larger grain size. It is therefore recommended that policy makers and plant breeders set breeding objectives to incorporate these traits of cowpea to spearhead the development and release of market-oriented varieties.

Key words: Choice experiment, Ghana, economic value, market-oriented varieties, plant breeding, *Vigna unguiculata*

Resume

Le niébé est consommé dans presque tous les foyers du Ghana et constitue le complément protéique le moins cher pour les populations pauvres des zones urbaines et rurales du pays. Afin de concevoir des programmes durables d'amélioration des cultures, les caractéristiques du niébé préférées des consommateurs doivent être intégrées dans les objectifs de sélection. Cette étude visait à examiner le comportement décisionnel des consommateurs ghanéens en matière de sélection de variétés de niébé et les valeurs qu'ils accordent aux différents traits du niébé. L'étude a été menée dans la municipalité de Techiman, dans la région de Bono East au Ghana, en utilisant une combinaison de méthodes d'échantillonnage intentionnel, aléatoire et accidentel pour sélectionner le district, les communautés et les consommateurs. La population cible était constituée en totalité de consommateurs de niébé de la municipalité. En utilisant un programme d'entretien structuré avec des cartes de choix, des entretiens en face à face et une expérience de choix ont été menés pour collecter des données auprès des répondants cibles. Enfin, les préférences des traits ont été analysées à l'aide du modèle Logit mixte (ML). Les résultats indiquent que les consommateurs préfèrent le niébé avec des périodes

de stockage plus longues, une couleur de grain blanche et une taille de grain plus grande. Il est donc recommandé que les décideurs politiques et les sélectionneurs de plantes fixent des objectifs de sélection pour incorporer ces caractéristiques du niébé afin d'encourager le développement et la diffusion de variétés adaptées au marché.

Mots clés : Expérience de choix, Ghana, valeur économique, variétés orientées vers le marché, sélection végétale, Vigna unguiculata

Introduction

In marketing, the most interesting consideration is reaction of consumers to products in the market place since the primary goal of marketing is its ability to define patterns of consumer choice. The marketer wants to know what makes a product attractive and what price consumers are willing to pay for a product, or for a specific feature of a product. One common product in many market centres is cowpea and is consumed in almost every home in Ghana and also in most countries in East, Central and West Africa (Afutu *et al*., 2016, 2017). Cowpea as a food source provides a cheap protein supplement to the urban and rural poor in Ghana. Eating habits of both poor and rich inhabitants of villages, urban and peri- urban areas come in various forms, as prepared for either directly cooked or processed food (Ibrahim *et al*., 20 13). Cowpea is consumed in many households in Ghana due to the numerous uses to which it can be put to. The usefulness of cowpea in this regard makes it a part of the food consumed in many households in Ghana.

Currently, the average yield of cowpea in Ghana is reported to be 1.3 tons per hectare (MoFA, 2016), although there are some cow pea lines with a yield potential of up to 3.4 tons per hectare (Afutu *et al*., 20 16). Some of these high yielding genotypes have now been introduced in Ghana and are being used in various breeding programmes. Apart from the wide yield gap which needs to be bridged, there is the need to improve cowpea for other attributes such as grain colour, grain size, time taken to cook, protein content, carbohydrate content, dry matter content, long term storability of the grains and resistance to biotic and abiotic stresses. When these other attributes are considered in formulation of plant breeding objectives, they lead to what is known as market-oriented research, thereby leading to the development and release of consumer preferred improved cowpea. More so, these attributes need to be considered with an assumption of a profit maximizing objective function when computing economic values of attribues to be included in a breeding programme. To complement the development of cowpea with high yield, there is the need to find the consumers' preferred attributes of cowpea in order for breeders to know the qualities that consumers of cowpea desire in a variety. The purpose of this study was to generate knowledge that would contribute to the development of market-oriented improved cowpea varieties by assessing consumers' preferences and how much they are willing to pay for cowpea traits in Ghana.

Study focus and approach. The study focused on the Techiman Municipality of the Bono East Region of Ghana. The study used quantitative research approach with cross-sectional and orthogonal factorial experimental designs. The target population for this study was the cowpea consumers of the selected municipality. Cowpea consumers included in this study have used or eaten cowpea or a related product before and were familiar with the attributes of cowpea.

For this study, a multi-stage sampling method was adopted - involving the selection of region, district, communities and cowpea consumers. Techiman Municipality in the Bono East Region was purposively selected based on (l) accessibility, and (2) the fact that cowpea is produced, traded and consumed in different forms by people from all walks of life — children, adults, students, various Ghanaian tribes, among others. Next, ten (10) communities in the municipality were randomly selected. Five to six

cowpea consumers were selected from each of the 10 communities. Hence, a total of 55 cowpea consumers were sampled for this study.

The main instrument for the study was a structured interview schedule with choice cards (based on choice experiment). An orthogonal fractional factorial design was used to generate the choice sets using some unique cowpea traits stich as grain colour, grain size, cooking time, storage period in addition to prevailing market price. Using focus group discussions among consumers, literature and expert consultation, four cowpea traits were selected and used to guide the design of the choice experiment. The fractional factorial design was used to generate the choice set by selecting subsets of choice sets from the full factorial design. A fractional factorial was used instead of full factorial design since very huge choice sets are difficult to handle in a choice experiment. This method has been widely used in similar studies. For example, Adamowicz *et al*. (1998), Revelt and Train (1998) and Acheampong (2015) utilized fractional factorial designs to generate choice sets using orthogonal main effects only designs. Since it is not practicable to work with such a large number of choice sets, partially orthogonal main effect design was generated from the full factorial design to create feasible choice sets using the experimental design technique in SPSS Conjoint software (SPSS, 2008) to obtain an orthogonal design, which consisted of only the main effects. The choice sets from the fractional factorial design were then used to generate cowpea profile alternatives - describing the differences in attributes and levels of cowpea. These profiles were presented to consumers in a hypothetical setting in a pictorial form. The alternatives were simply bundle of attributes and the objective was to assess which attributes were important drivers of choice.

Using Choice Experiment (CE), face-to-face interviews were conducted to collect data from the target consumers of cowpea over a period of two weeks. With the help of STATA software package, consumers' cowpea trait preferences and heterogeneities were analyzed using the Mixed Logit (ML) model as described by McFadden and Train (2000), Train (2003), Hensher *et al*. (2005), Greene et al. (2006) and Ouma (2007). The ML model was applied to empirically model the choices made by the decision makers (consumers) from the choice experiment survey and to estimate economic values of the cowpea traits.

Findings and Impact of the Study

The results from the base model (conditional logit model) indicated that the consumers prefer cowpea with longer storage period, white grain colour, larger grain size and at cheap price (Table 1). The estimated coefficients for cowpea traits used in this study were all positive and significant at 5 percent (0.05) except the purchase price, and this not surprising as it was expected. The consumers also prefer less cooking time (negative coefficient) to longer cooking times though not significant. Interestingly, the status quo was also significant brit negative indicating that the cowpea consumers prefer less of that. The result also shows disutility for the length of time taken to cook cowpea which means people do not really care about how long it may take them to cook cowpea partly because cowpea does not take long to cook.

The estimated mean and standard deviation coefficients from the mixed logit model for the cowpea traits (Table 2) indicated a strong statistical significance (at 1 % level) of the mean coefficients of cowpea traits except grain size and length of cooking time that were only significant at 5 percent and 10 percent level, respectively. The signs coefficients of the random parameters were expected. The conditional logit model and mixed logit model both revealed that consumers' preferences for cowpea depended on grain colour, storage period, grain size and the purchase price. This means that none of the models fitted the data better than the other. However, the mean coefficients in the mixed logit model were larger than the fixed coefficients in the conditional logit model. This phenomenon has been explained by Revelt and Train (1998) that the large coefficient values frequently obtained from

mixed logit estimates relative to the conditional logit red ecus one thing - the fact that the mixed logit model tends to decompose the unobserved portion of utility and normalizes parameters on the basis of part of the unobserved portion of the model.

Table 1. Conditional logit estimates for cowpea traits preferences

Choice	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Status quo	-1.58059	.5278548	-2.99	0.003	-2.615166	-.5460133
storagePeriod	.8156908	.1797894	4.54	0.000	.4633101	1.168072
GrainColour	1.169791	.1751381	6.68	0.000	.8265263	1.513055
_Icookingtime_2	-.2366503	.1725123	-1.37	0.170	-.5747681	.1014675
_Icookingtime_3	-.1538	.1815108	-0.85	0.397	-.5095546	.2019546
GrainSize	.3532614	.1720213	2.05	0.040	.016106	.6904169
Purchase_price	-.1745479	.0659144	-2.65	0.008	-.3037377	-.045358
No. of observation	1,320					
Log likelihood	254.01					
LR chi2(7)	0.0000					
Log likelihood	-356.38314					
Pseudo R2	0.2627					

The results in Table 2 revealed that the standard deviations of all random parameter coefficients were not significant except grain colour and the status quo that were highly significant at 1 percent level, indicating that their preferences were not entirely heterogeneous in the population. This implies that they possessed individual-specific parameter estimates with respect to the colour of grain that may be different from the sample. However, regarding the other traits their individual specific parameter estimates may be the same as that of the sample population mean parameter estimates.

Implicit trait prices from the mixed logit model have been derived using individual conditional constrained parameter estimates. The results (Table 3) of willingness to pay (WTP) for cowpea traits showed that the consumers were willing to pay GH¢7.89 more for grain colour than for the other attributes. They also valued storage period and grain size at GH¢5. 12 and GH¢2.03, respectively. In fact, cowpea consumers were willing to pay as high as GH4 11 .64 less for the status quo which was alarming. This suggests that the consumers did not Iike what they currently consume but they are still consuming because there are no alternatives on the market. The results also showed that the WTP estimates of cowpea traits from the mixed logit model were all statistically significant.

The finding provides great possibility to release market-oriented and preferred cowpea varieties it the preferences of the consumers are taken into consideration by breeders. For the purpose of policy, consumers' high preferences for cowpea with larger grain size, longer storage period, white grain colour and at cheap price gives an indication that cowpea genotypes with these traits or attributes would speed its adoption, hence increased consumption.

Conclusion and recommendation

We conclude that consumers in the Techiman Municipality have high preferences for longer storage period, white grain coloured cowpea, large grain size but demonstrated disutility for longer cooking time. It is also important to state that they prefer less of the status quo (what they currently consume). It recommended that breeders in formulating their breeding objectives, should incorporate these traits of cowpea in development and release of market-oriented varieties. As has mostly been the case, plant

breeding programmes have mainly been designed to develop new crop varieties with resistance or tolerance to one biotic/abiotic stress factor or the other, while trait preferences of consumers are relegated to the background. In as much as most breeders considers what is desired by farmers (in some instances), breeding programmes would have to culminate in development of highly preferred varieties that would easily be marketed and consumed to help achieve the food and nutritional security that is being targeted in most Sub-Saharan African countries. Improved yields, coupled with ease in marketing would lead to increased income to cowpea growers, thereby improving their livelihoods. This would result in increased adoption and cultivation of such improved varieties.

Table 2. Mixed Logit Estimates for Cowpea Traits Preferences

Choi	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Heterogeneity Mean						
GrainSize	0.36648	0.177511	2.06	0.039	0.018566	0.714395
_Icookingtime_2	-0.32701	0.190056	-1.72	0.085	-0.69951	0.045495
_Icookingtime_3	-0.23149	0.213549	-1.08	0.278	-0.65004	0.187055
GrainColour	1.425794	0.277157	5.14	0.000	0.882577	1.969012
StoragePeriod	0.925759	0.201965	4.58	0.000	0.529915	1.321604
Purchase_Price	-0.18066	0.069372	-2.6	0.009	-0.31662	-0.04469
Sq	-2.102	0.658061	-3.19	0.001	-3.39177	-0.81222
Heterogeneity SD						
GrainSize	-0.01012	0.287208	-0.04	0.972	-0.57304	0.552795
_ICookingTime_2	-0.01173	0.302112	-0.04	0.969	-0.60386	0.580403
_ICookingTime_3	0.485867	0.424392	1.14	0.252	-0.34593	1.31766
Graincolour	1.110636	0.377664	2.94	0.003	0.370429	1.850843
StoragePeriod	0.014719	0.497703	0.03	0.976	-0.96076	0.990199
Purchase_Price	-0.00943	0.116105	-0.08	0.935	-0.23699	0.218131
Sq	1.526633	0.496929	3.07	0.002	0.55267	2.500596
No. of observation						
1,320						
Log likelihood	-352.25641					
LR chi2(7)	8.25					
Prob > chi2	0.3108					

Table 3. Willingness to pay for cowpea traits

	GrainSize	Icookingti_2	_IcookingTi_3	GrainColour	StorageP	Status Quo
wtp	2.0286009	-1.8101035	-1.2814049	7.8922902	5.1244155	-11.635308
LowerLimit	-.84218326	-4.1283236	-3.487946	1.2961523	.93109134	-17.026756
UpperLimit	4.8993851	.50811661	.9251362	14.488428	9.3177397	-6.2438601

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