Willingness-to-pay for iodine biofortified vegetables: Results from open-ended choice and bilateral bargaining experiments

Solomon Olum[1,2], Xavier Gellynck[1], Duncan Ongeng[2], Hans De Steur[1]

[1]Department of Agricultural Economics, Ghent University, Belgium
[2]Department of Food Science and Postharvest Technology,
Gulu University, Uganda

Abstract

A lot of efforts have been made globally to improve the iodine content of staple foods through biofortification, but acceptance and willingness to pay (WTP) studies are limited. While WTP has been applied to other biofortified crops, such studies have evaluated WTP for a single unit of food products, when in reality, consumers often buy more than one unit. This research estimated the initial demand for iodine biofortified cabbage and cowpea in Uganda using open-ended-choice-experiment (OECE) that allows to estimate consumer demand for multiple units of products. In addition, it introduces bilateral bargaining to the consumer WTP literature to estimate the possible transaction boundaries between the producers and the consumers. Results show that consumers are willing to pay high premium for the two crops. They are willing to pay higher premium for the cowpea than for the cabbages, as cowpea is consumed more than cabbages in the study area. To this stage, bargaining is seen to produce comparable results to OECE. The study provides key information for producers and authorities on how to value iodine biofortified cabbages and cowpea, once produced. It also emphases the need to integrate bargaining to other established methods of estimating consumers' WTP, especially in those regions where bargaining is common in food markets.

Introduction

The intake of iodine is low in most countries, just as it is with the intake of four other micronutrients; Iron (Fe), Zinc (Zn), folate and vitamin A, making their deficiencies the most wide spread globally (Bailey, West Jr, & Black, 2015). The cereal based foods that dominate the diets of most households in many developing countries, are low in these essential micronutrients, which lowers their intakes in those countries (Bouis & Saltzman, 2017). In the case of iodine, its low density in most crops are due to the low amounts of iodine in the soil (Fuge & Johnson, 2015; Gonzali, Kiferle, & Perata, 2017), leading to low plant uptake and accumulation.

There have been efforts in the last 2 decades to increase the micronutrient density of food crops through biofortification. It is a strategy that targets the staple foods that are widely consumed by poor households in developing countries and it is achieved by breeding crops that are high in specific micronutrients (Saltzman et al., 2017). Successes have so far been registered in biofortifiying and distributing foods biofortified with Fe, Zn, folate and Vitamin A. For example, the pro-vitamin A beta-carotene biofortified orange-fleshed sweet potatoes (OFSP) has already reached about 2.8 million households in sub-saharan Africa (SSA), with evidence of reduction in vitamin A deficiency (Low, Mwanga, Andrade, Carey, & Ball, 2017). The iron biofortified beans and millet has been consumed in India, Rwanda and Guatemala among other countries, with 30-50% of the daily recommended iron intake being met by consumption of the biofortified foods (Birol, Meenakshi, Oparinde, Perez, & Tomlins, 2015; Petry, Boy, Wirth, & Hurrell, 2015). Folate rich rice has been viewed as favorable in china and other countries through acceptance studies (De Steur et al., 2013; De Steur, Liqun, Van Der Straeten, Lambert, & Gellynck, 2015; Talsma, Melse-Boonstra, & Brouwer, 2017). Overall, it is postulated that over 20 million people in farming households now have access to foods biofortified with one or more of these micronutrients (Fe, Zn, Folate and Vitamin A) (Bouis & Saltzman, 2017). These biofortification efforts have been through conventional plant breeding, genetic engineering and agronomic approach. Agronomic biofortification, involving application of micronutrient rich fertilizers, is most suited for crops that are produced in micronutrient deficient soils (Saltzman et al., 2017). Thus, iodine biofortification effort has mainly been applied using the agronomic channel, because iodine is limiting in most soils. There are specific evidences of the efficiency of different crops in different countries to uptake and accumulate iodine applied as fertilizer. These include iodine accumulation by lettuce (Blasco et al., 2008; Lawson, Daum, Czauderna, Meuser, & Härtling, 2015; Lawson, Daum, Czauderna, & Vorsatz, 2016; Smoleń, Kowalska, & Sady, 2014; Smoleń, Skoczylas, Ledwożyw-Smoleń, Rakoczy, Kopeć, Piątkowska, Bieżanowska-Kopeć, Pysz, et al., 2016); tomatoes (Caffagni et al., 2011; Halka et al., 2018; Kiferle, Gonzali, Holwerda, Real Ibaceta, & Perata, 2013; Landini, Gonzali, & Perata, 2011); pea plants (Jerše et al., 2018), carrots (Piątkowska et al., 2016; Smoleń, Skoczylas, Ledwożyw-Smoleń, Rakoczy, Kopeć, Piątkowska, Bieżanowska-Kopeć, Koronowicz, et al., 2016) and other crops such as maize, rice and wheat (Cakmak et al., 2017).

More recently, agronomic experiments have been conducted in Northern Uganda, which have shown that, two widely consumed and economically important vegetables; cabbages and

cowpea, are able to absorb and accumulate to nutritionally important levels, exogenous iodine applied as foliar fertilizer. Previously different categories of stakeholders in Uganda have been shown to be positive about iodine biofortification (De Steur, Mogendi, Wesana, Makokha, & Gellynck, 2015; Olum et al., 2018). However, the success of the iodine biofortification effort will depend not only on their appreciation but also willingness to pay (WTP) for the iodine biofortified products. Consumers' WTP have been widely examined and applied to the case of biofortified crops (De Steur, Demont, Gellynck, & Stein, 2017; Mogendi, De Steur, Makokha, & Gellynck, 2016; Oparinde, Banerji, Birol, & Ilona, 2016), although very few are applied to iodine biofortified foods. In addition, most of the studies have investigated demand and WTP for a single unit of food products, while in reality, consumers usually buy more than one unit of the products. This study evaluated consumers' demand for successive units of iodine biofortified vegetables (cabbages and cowpea) in Uganda, using Open-ended Choice Experiment (OECE). In addition, the study applied a bargaining approach to establish the possible transaction boundaries between the sellers (producers) and the buyers of the iodine bio fortified vegetables.

The OECE has been applied to food-related economic literature as it very well replicates the typical consumer purchase behavior of buying more than one unit of products (Elbakidze & Nayga Jr, 2012; Hovhannisyan & Khachatryan, 2017; Pappalardo, Chinnici, & Pecorino, 2017; Wongprawmas, Pappalardo, Canavari, & Pecorino, 2016). Unlike in Discrete Choice Experiments (DCEs), where participants are presented with one or more goods of different attributes and asked to choose the one they prefer, and the name-your price practice in the experimental auctions, the OECE presents different price combinations and tasks the participants to name the quantities of the products that they desire at those price combinations. As such, they can choose to buy as many quantities as they like, something very similar to what retailers do every time they visit a food market.

Bargaining on the other hand, has been applied to few procurement auction studies, and only in the cases where, the buyers wanted to attract favorable prices from the sellers after an auction process (Huang, Xu, Kauffman, & Sun, 2013; Huh & Park, 2010). While there are studies combining procurement auctions (more producer-oriented) with a bargaining process to determine the final prices, there are no consumer WTP studies that include bargaining process. In addition, no studies, including the supply oriented auction studies aforementioned, has applied bargaining to establish the possible transaction boundaries between the producers (sellers) and the buyers (consumers). The contribution of this study is to; 1) estimate the initial demand for iodine biofortified cabbages and cowpea in Northern Uganda and assess WTP for the multiple units of the food products using the OECE, and 2) extend the use of bilateral bargaining to the consumer WTP literature and to use it to estimate the possible transaction boundaries (zone of possible agreement) between the buyers and the sellers of iodine biofortified vegetables. Bargaining is a cultural bidding technique that is common in many non-western cultures of developing countries. The study takes place in Northern Uganda, where bargaining is a common practice in determining whether or not the buyer purchases the food product, and the final price that he or she pays. We have estimated the initial demand for successive units of iodine biofortified vegetables (cowpea and

cabbages) in the region and identified possible transaction boundaries for the two vegetables in the region.

Materials and methods

Study participants and location

The study targeted adults who are responsible for food purchase or making key decisions on food purchase in the household. The participants were screened by; 1) asking them if they eat the vegetables under study. If they do not eat the food stuff, they were not interviewed as they could not reveal the true demand for the products, 2) being an adult. Only adults 18 years and above were interviewed because these are assumed to make key and independent decisions on what to buy, 3) they were responsible for food purchase or decision making for food purchase, 4) they were willing to participate after the objective of the study were read to them. The study took place in Lira and Gulu districts. The two districts are purposely selected for being the most economically viable districts in Northern Uganda and for having hosted agronomic experiments for the iodine biofortification of cabbages and cowpea. In addition, cabbages and cowpea which are the products under study, are widely consumed and traded in the two districts. One rural and one urban sub-county were selected from each district by simple random sampling from the list of the rural and urban sub-counties in each district. Finally, the study participants, one per household, were conveniently sampled from villages within the sub-counties. There were 272 participants sampled for the OECE but 5 of them did not complete the study, resulting into 267 participants. The bargaining experiments took place in only one sub-county in each of the districts. We decided to use separate participants from those who participated in the OECE to reduce fatigue caused to the participants, but mostly to minimize the effect of reduction in demand when they would participate in multiple experiments (Shi, Xie, & Gao, 2018). We also wanted to avoid the potential change in purchase behavior when the participants knew that they would participate in two different experiments (Wongprawmas et al., 2016). 5 farmers (producers) and 60 buyers (consumers) participated in the bargaining experiment but only 58 consumers completed the study.

Products studied

The study targeted cabbage (*Brassica oleracea*) and cowpea (*Vigna unguiculata*) which are widely eaten in Northern Uganda. While cabbages are eaten all over the country, cowpea is more culturally produced and eaten in Northern Uganda compared to any other part of the country. All the two vegetables are extensively produced and marketed in the region. Cowpea is not only an important crop in Northern Uganda, it is also among the most economically important legume crops in Africa (Okonya & Maass, 2014) and a good source of vegetable proteins in many tropical regions (Adipala, Nampala, Karungi, & Isubikalu, 2000; Orawu, Obuo, & Omadi, 2015). In fact, it is the third most important legume in Uganda, after groundnuts (*Arachis hypogea*) and common beans (*Phaseolus vulgaris*) (Afutu, Mohammed, Odong, Biruma, & Rubaihayo, 2016; Okonya & Maass, 2014). Its production and consumption is highest in Northern Uganda (Orawu et al., 2015), where it is grown for both the leaves which are used as vegetables and the grains for seeds and consumption.

The study included both the iodine biofortified vegetables and their substitutes (non-biofortified vegetables), the latter being sold on the market. The participants were informed that the two types of vegetables (biofortified and conventional) were equal in size (1.5kg for cabbages and 300g for cowpea leaves) and same in all other characteristics, except that one was biofortified to increase the level of iodine and the other not biofortified (similar to what they commonly find in the market).

Data collection

Data were collected through face to face interview with the aid of a pre-tested questionnaire and an OECE price set. The questionnaire collected information on the socio-economic characteristics of the respondents and their households, frequency of consumption of vegetables, main sources of the vegetables consumed (e.g. from own production, purchase) and on their level of health consciousness using questions adapted from previous studies that measured consumers' health consciousness (Chen, 2013; Hoque, Alam, & Nahid, 2018; Michaelidou & Hassan, 2008).

The OECE price combinations were designed based on the survey of the prices of conventional cabbages and cowpea in the local markets around the study areas. Based on the survey, the price of a 1.5 kg head of conventional cabbage was fixed at 1000 while the price of the same size of iodine biofortified cabbage was varied below and above the price of the conventional one, in order to be able to capture the range of prices over which consumers would show their willingness to pay for iodine biofortified cabbage. After a pre-test, the prices were modified and the final prices for iodine biofortified cabbage ranged from 500 to 2500 Ugandan shillings (Ugx). The price of a 300g of conventional cowpea leaves was fixed at 500 Ugx while the price for the same size of iodine biofortified cowpea leaves was varied from 300 to 1500 Ugx. The inclusion of prices lower than the price of the conventional food stuff in the market is to reduce bias in bidding when we would have presented the iodine biofortified vegetables as more expensive, "better" products but also to be able to capture the possible demand of consumers for the iodine biofortified vegetables at different prices.

The participants were presented with both the conventional vegetables (bought from local markets) and biofortified vegetables (from an iodine agronomic experiments). Regarding the weights, only the cabbages weighing 1.5 ± 0.1Kg were selected, while the cowpea leaves (conventional and biofortified) weighed 300g. The participants were asked to indicate how many units of each of the products (conventional vs biofortified) they would purchase at a given price combination. See table 1 for the cabbage price scenarios. The valuations for cabbages and cowpea were done one at a time. In all the experiments, participants were reminded to be honest while stating the quantities that they would buy and they were told the value of honesty in this kind of study, through a cheap talk (Radmehr, Willis, & Metcalf, 2018). In addition, the participants were informed that they could indicate zero (0) in case they would not be interested to buy a particular product at a given price.

Table 1: Sample OECE form for cabbages

At these prices, how many heads of cabbages would you buy?			
Price combinations (Ugx)		**Number of heads of cabbages desired (1.5kg each)**	
Conventional cabbages	Iodine rich cabbages	Conventional	Iodine rich cabbages
1000/=	500/=	……	……
1000/=	800/=	……	……
1000/=	1000/=	……	……
1000/=	1500/=	……	……
1000/=	2000/=	……	……
1000/=	2500/=	……	……

Bargaining session

The exisiting bargaining studies have mainly considered supply-side stakeholders (producers, processors, cooperatives)(Ge, Flores-Lagunes, & Kilmer, 2015). In the current study, we extended bargaining to consumers, each seller (vegetable producer) was given a chance to negotiate with 10-15 potential buyers of iodine biofortified vegetables. Before the negotiation, a trained facilitator met the producers and after discussing with him or her, the value of iodine in the diet, they were asked to name their reservation price for each product, as the least price they would accept from any buyer for a given unit of iodine biofortified product (1.5 Kg head of cabbage and 300g of cowpea leaves). This reservation price was kept confidential between the seller and the facilitator, so that the different buyers would negotiate their own prices for the products, without being affected by the price of the producer. Potential buyers were then invited one at a time. They were briefed of the objective of the study, told about iodine bio fortification and importance. After registering their willingness to voluntarily participate in the study, they were told the importance of being honest while stating the prices they would pay. Once they had understood, they were presented with the iodine biofortified vegetables (cowpea and cabbage), one at a time and asked to bargain with the producer (herein the seller). As a starting point, the seller reminded each buyer of the price of an equivalent size of the conventional (non-biofortified) vegetable in local market. The negotiation went on as the facilitator guided. At the point when the two parties had agreed on the purchase price, the buyer's maximum price was noted. The bargaining was considered successful, if the buyer's maximum stated price was equal to or above the seller's reservation price, otherwise it was unsuccessful and the buyer's price was noted. Each buyer also completed a socio-demographic and health consciousness questionnaire and was given a gift for participating in the bargaining.

Data analysis

Analysis ongoing, so choice of methods may differ depending on whether assumptions are met and objectives are reached

The responses obtained from the OECE were the quantities of cabbages and cowpea (conventional and iodine biofortified) demanded by each participant at a range of price combinations. The maximum WTP by the consumers for a single unit of iodine biofortified cabbage and cowpea was estimated as the highest price at which they indicated a positive quantity of the products. In addition, as participants could state any non-negative quantity at a given price, their demand curve could be estimated across the different price ranges. Willingness to pay from the bargaining experiment is estimated as the maximum price stated by the buyer during the bargaining session with the producer. Descriptive statistics analysis was used to estimate the mean and median demand at each price level and summarize the socio-demographic characteristics of the participants. In order to aggregate consumer demand at each price, we sum individual participant demand at that price (Wongprawmas et al., 2016).

Given the count nature of the quantities demanded at different prices, we employed poisson regression to estimate the effect of price on the quantity demanded of the iodine biofortified vegetables. Other factors such as socio-demographic variables, and the level of health consciousness of participants were added to the model.

Results and discussion

The socio-demographic profile of the 267 OECE and 63 bargaining participants are presented in Table 2. There are no remarkable differences among the two samples in terms of the socio-economic characteristics, except that a significantly higher proportion of the bargaining participants reported that their main source of vegetables is from purchase as compared to the OECE participants who have a fairly higher proportion of participants who consume vegetables from their own farms. Majority of the participants were female, married, with at least a primary level education attainment.. However, less than 20% had a prior knowledge of the importance of iodine in human diet. The significantly higher proportion of female as compared to the male in the samples is expected as women are in most cases the sole responsible persons for food purchase in a typical Ugandan household. Majority of the participants have experienced the two most common forms of IDDs, namely goiter and cretinism. This is in line with a previous study in the same region in which the participants reported that IDDs is common in their area and that they have often seen goiter cases in the community (Olum et al., 2018).

Table 2: Socio-economic characteristics of participants surveyed

Variable	Response	OECE (N=267) Mean (SD)	Bilateral bargaining (N=63) Mean (SD)
Age		34.5 (0.85)	31 (1.22)
Household size		5.6 (2.5)	5.4 (2.85)
Estimated monthly income		386,492.5 (26,327)	401,746 (50,826)
Gender	Male	18%	12.70%
	Female	82%	87.30%
Location	Lira district	53.90%	50.80%
	Gulu district	46.10%	49.20%
	Rural area	40.40%	
	Urban area	59.60%	
Marital Status	Single	8.60%	9.50%
	Married	73.80%	76.20%
	Divorced	6%	6.30%
	Widowed	11.60%	7.90%
Education attained	No formal education	12%	7.90%
	Primary education	55.10%	41.30%
	Secondary education	27.30%	41.30%
	Some college education	5.60%	9.50%
Occupation	Farming	28.80%	14.30%
	Casual labouring	11.60%	15.90%
	Business (self-employment)	54.30%	61.90%
	Civil servant	5.20%	7.90%
Household main source of vegetables consumed	Own production	36.30%	12.70%
	Purchase	60.30%	87.30%
	Gift	3.40%	
Did you know about the importance of iodine before the survey?	Yes	19.90%	
	No	80.10%	
Experience of goiter	I current have goiter	1.90%	
	I have had goiter	3.40%	
	a relative has/had goiter	22.50%	
	I often see goiter cases	36.70%	
	I rarely see goiter cases	26.60%	
	I have never seen goiter	9%	
Experience of cretinism	a relative has or had cretinism	10.90%	
	often see cretin children	42.70%	
	rarely see cretin children	38.60%	
	never seen a cretin case	7.90%	

Willingness to pay for iodine biofortified vegetables

The summary statistics for the quantities demanded of the iodine biofortified cabbages and cowpea are presented in Table 3, while the maximum willingness to pay for the products is presented in Table 4. The mean maximum price that participants are willing to pay for a single head of cabbage (approximately 1.5kg) was 2,222 Ugandan shillings (about 0.6 USD) and 2,846.6 Ugx (0.77 USD) in the OECE and bargaining experiments, respectively. Comparing these results to the price of the same size of the conventional cabbage (1,000 Ugx), it shows that the consumers are on average willing to pay a premium of 122.2% and 128.66% for the 1.5 Kg head of iodine biofortified cabbages in the OECE and bargaining sessions, respectively. In the case of cowpea, the average maximum willingness to pay was 1, 325 Ugx (0.36 USD) and 1,098 Ugx (0.30 USD) in the OECE and bargaining sessions, respectively, for a 300g bundle of iodine biofortified cowpea leaves, compared to the price of the conventional cowpea of the same size (500 Ugx). This shows a premium of 165% and 119.6% for the OECE and bargaining experiments, respectively. However, given that WTP was not assessed in the same way among the OECE and bargaining participants (OECE participants stated the quantities at different prices, while bargaining participants stated the maximum price they would pay for a single unit of each product), we don't have the basis to compare the results statistically. However, we provide the 2 sets of results to show to the producers and regulators, the possibilities to market the iodine biofortified products when wide spread cultivation will start. In addition, we show that bargaining which is a common bidding method in many non-western cultures in Africa, can produce results comparable to the formal WTP valuation methods. This cultural bidding methods needs to be integrated into WTP studies in Africa and other places where it is practiced.

The objective of this study was to provide producers and potential investors with the initial consumer demand assessments for iodine biofortified cabbages and cowpea in Northern Uganda. The higher WTP premium for the two vegetables when biofortified with iodine, shows that these widely consumed crops have the potential to help reduce IDDs, which are prevalent in Northern Uganda (Olum et al., 2018). In terms of economic benefits, the two crops are widely marketed in the region (Afutu et al., 2016). The results of this study shows that biofortifying them with iodine increases their prices and market potential, making them very well suited for farmers who grow them for the market. Efforts to biofortify the two crops could also result into improvement in the livelihood of the growers. This is because the crops are often grown and marketed by poor small scale farmers in Northern Uganda as compared to cereal crops that are produced and marketed in more established market by large scale producers. The high WTP values obtained in this study relates to the fact that the two crops are largely eaten in the study area. Both of these vegetables are eaten almost like other staple foods such as maize and rice. Lombardi, Vecchio, Borrello, Caracciolo, and Cembalo (2019) show that when you introduce a trait or an ingredient into a commonly consumed staple, it would not modify the routine of eating that food by the people, hence leading to higher WTP. The authors found out that their samples were on average willing to pay higher premium for insect based pasta, than insect based cookies and chocolates because pastas are more routinely eaten in Italy, where they conducted the study. In fact in the current study, a higher premium is seen for cowpea (165%) compared to cabbages (122%), something that seems to

be related to the higher and more frequent consumption of cowpea than cabbages in the study area (Northern Uganda). The acceptance of biofortification depends on whether the biofortified foods are accepted, cultivated and consumed by the population (Meenakshi et al., 2012; Meenakshi et al., 2010). Acceptance of such foods have been seen to depend on how the consumers perceive the biofortified foods and their preference for the organoleptic traits (e.g. taste) in the foods (Pérez, Oparinde, Birol, Gonzalez, & Zeller, 2018). This may explain the observed high WTP for the increased iodine level in the two vegetables that are more routine in the typical diet of consumers in Northern Uganda.

Table 3: Statistics on quantities of iodine biofortified cabbages and cowpea desired at different prices

Quantities of iodine biofortified cabbages				Quantities of iodine biofortified cowpea			
Price (Ugx)	**Median**	**Mean**	**SD**	**Price (Ugx)**	**Median**	**Mean**	**SD**
500	4	5.16	4..15	300	5	5.48	3.19
800	3	4.54	3.48	500	4	4.85	2.81
1000	3	3.96	3.52	700	3	4.06	2.87
1500	2	2.98	2.7	1000	2	3.13	3.11
2000	2	2.3	2.54	1200	2	2.6	3.13
2500	1	1.68	2.6	1500	2	2.18	3.4

SD: Standard deviation

Table 4: Maximum willingness to pay for iodine biofortified cabbages and cowpea in Northern Uganda

	OECE experiment (n=267)				Bargaining experiment (n=58)			
Products	**Lowest**	**Highest**	**Median**	**Mean (SD)**	**Lowest**	**Highest**	**Median**	**Mean (SD)**
Cabbages	800	2,500	2,500	2,222 (450.6)	800	15,000	2,500	2,846.6 (1,994)
Cowpea	0	1,500	1,500	1325 (272.2)	300	5,000	1,000	1,098.3 (866.8)

Prices are in Ugandan shillings (Ugx): 1 USD equals to 3700 Ugx at the time of data collection

Aggregate demand for iodine biofortified vegetables

The aggregate quantities of iodine biofortified vegetables demanded at different prices are presented in Tables 5 (cabbages) and Table 6 (cowpea) and the demand curves are presented in Figures 1 and 2. As expected quantities decreased with increase in the price of the products. The demand curves shows a negative relationship between price and quantities demanded. We have also presented the demand for conventional (substitute) products (cabbages and cowpea) whose prices are fixed at the market price. It has been argued that prospective products should be evaluated, in the context of realistic substitute goods already present in the market (Maynard et al. 2004; Wongprawmas et al. 2016). As such, the participants in the current study were offered both the new products (iodine biofortified cabbages and cowpea) and the conventional cabbages and cowpea, already in the market, for accurate valuation. However, the field substitutes used are readily available in the markets outside of this experiment. As such, we cannot claim that the aggregate quantities of the conventional

(substitute) products reported in this study, reflects the demand of the products given the introduction of the iodine biofortified cabbages and cowpea. We have only used the conventional products as explicit reminder of the field substitutes available in the outside market. There are evidence that economic evaluation participants take into consideration the field alternatives when making bids for novel products (Harrison, Harstad, & Rutström, 2004; Lombardi et al., 2019).

Table 5: Aggregate quantities of iodine biofortified and conventional cabbages (1.5kg) desired at different prices

Lira (n=144)				Gulu (n=123)			
Iodine biofortified cabbages		Conventional cabbages		Iodine biofortified cabbages		Conventional cabbages	
Price (Ugx)	**Quantity**	**Price (Ugx)**	**Quantity**	**Price (Ugx)**	**Quantity**	**Price (Ugx)**	**Quantity**
500	732	1000	147	500	647	1000	109
800	655	1000	140	800	556	1000	88
1000	603	1000	129	1000	455	1000	68
1500	450	1000	147	1500	345	1000	55
2000	377	1000	113	2000	236	1000	78
2500	279	1000	122	2500	169	1000	98

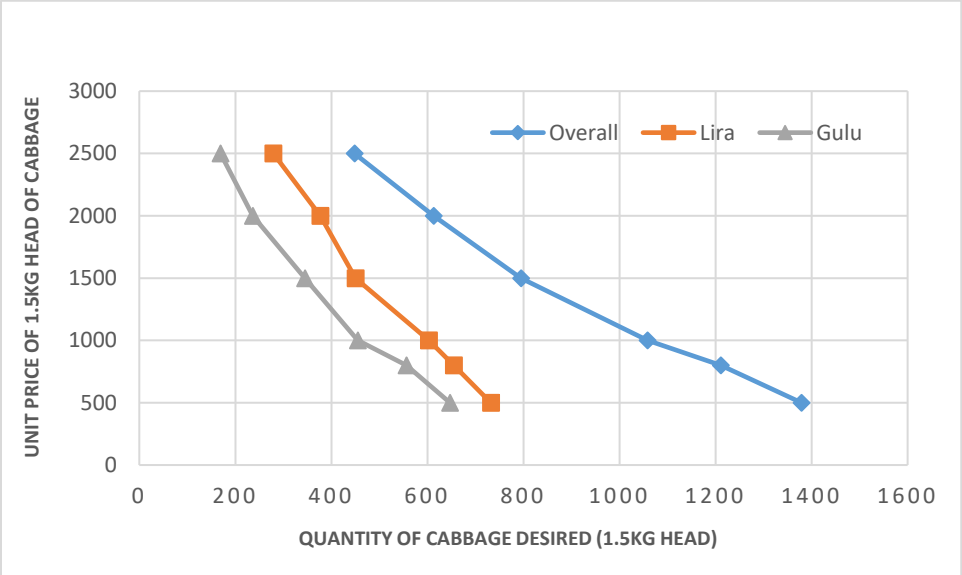

Figure 1: Observed aggregate demand for iodine biofortified cabbages in Lira and Gulu districts of Northern Uganda

Table 6: Aggregate quantities of iodine biofortified and conventional cowpea (300g) desired at different prices

Lira (n=144)				Gulu (n=123)			
Iodine biofortified cowpea		Conventional cowpea		Iodine biofortified cowpea		Conventional cowpea	
Price (Ugx)	**Quantity**	**Price (Ugx)**	**Quantity**	**Price (Ugx)**	**Quantity**	**Price (Ugx)**	**Quantity**
300	796	500	188	300	666	500	146
500	716	500	134	500	580	500	127
700	630	500	136	700	454	500	145
1000	526	500	141	1000	310	500	133
1200	457	500	152	1200	236	500	127
1500	383	500	126	1500	199	500	118

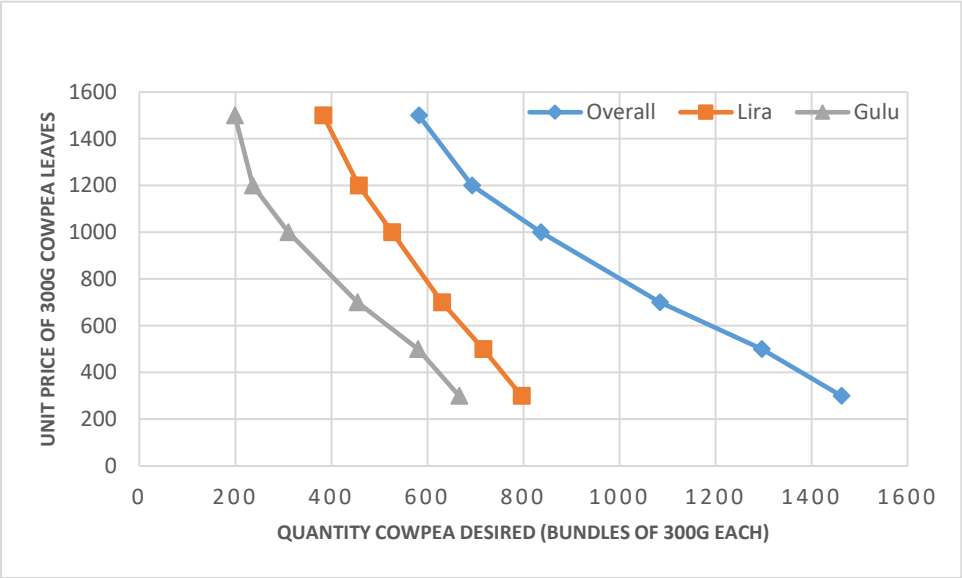

Figure 2: Observed aggregate demand for iodine biofortified cowpea in Lira and Gulu districts of Northern Uganda

STILL TO DO

- More results from bargaining e.g. transaction boundaries
- Regression for determinants

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