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Will they buy it? The potential for marketing organic vegetables in the food vending sector to strengthen vegetable safety: A choice experiment study in three West African cities

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ABSTRACT

Considering the hazardous use of synthetic pesticides in vegetable production in urban West Africa, this research investigated the marketing potential of organic vegetables in the food vending sector of Cotonou (Benin), Accra (Ghana) and Ouagadougou (Burkina Faso). Certified organic production and marketing was examined as a potential strategy to improve chemical food safety. A stratified random sampling strategy was applied to study the preferences of food vendors (n = 180) and consumers (n = 360); vegetable use, risk perception, choice preferences and willingness-to-pay (WTP) for organic certification were specifically analyzed. The results showed that awareness of chemical contamination risks was generally low. Appearance of a product was central to vendor choice; consumers attributed similar utility to taste and organic certification. Consumer WTP was calculated to be a premium of 1.04 USD (per plate) if the food served contained only certified organic vegetables. In restaurants, this would mean an average premium of 19% for a meal. If certified organic vegetable production is to make a positive impact on food safety in urban West Africa, we suggest concentrating marketing efforts on the educated "elite" who frequent restaurants. However, considering that restaurant owners exhibited a lower preference for organic certification than lower class food vendors, the marketing situation is difficult. We therefore conclude that demand from the food vending sector alone will not institutionalize domestic certification mechanisms; this underlines the need for public commitment to facilitating such change.

Introduction

Ongoing urbanization trends in West Africa, including the study sites of Cotonou (Benin), Accra (Ghana) and Ouagadougou (Burkina Faso) (Ghana Statistical Service, 2008; Institut National de la Statistique et de l'Analyse Economique, 2008; UN-Department of Economic and Social Affairs, 2009), and a shift in dietary habits towards consuming food outside the home have contributed to the increasing importance of food vending businesses as providers of ready-made food for urban dwellers (Bendech et al., 2000; Loprirore and Muehlhoff, 2003; Maxwell, 2000; McCullough et al., 2010; Nago et al., 2010; Ndoye, 2001). Food purveyors, such as street food vendors, fast food outlets, "maquis" and restaurants are important consumers of vegetables from urban production. In Accra, more than 280,000 people consume uncooked vegetables outside their households each day according to Obuobie et al. (2006). The authors further state that 98% of all lettuce traded in Accra is consumed in food vending businesses.

In general, urban vegetable production is a common phenomenon in the region: in open spaces of airport entry lanes, under power lines and along water bodies, farmers engage in the commercial cultivation of vegetables for the local market (Assogba-Komlan, 2005; Brock, 1999; Cissé et al., 2002; De Bon et al., 2010; Obosu-Mensah, 1999; Obuobie et al., 2006).

As farmers attempt to meet growing demand and are faced with strong pest pressure particularly on "exotic" crops like cabbage and lettuce, they increasingly rely on synthetic pesticides to reduce the risk of harvest and income loss (Bassolé and Ouedraogo, 2007; Gerken, 2001; Lund et al., 2010; Williamson et al., 2008; Wollf, 1999).

Farmers frequently abuse, misuse and overuse pesticides (Bassolé and Ouedraogo, 2007; Boadi, 2004; Clarke, 1997; Lund et al., 2010; Ntow et al., 2006; Rosendahl et al., 2008); this practice has raised concerns about negative health effects for both farmers and consumers.

Documentation on acute and chronic exposure risks is limited, but gives reason for major concern: Amoah et al. (2006) and

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Assogba-Komlan and Anihouvi (2007) proved that, in Accra and Cotonou respectively, vegetables are contaminated with different pesticides exceeding minimum residue levels; and a more recent study in Cotonou uncovered illegal pesticides and high residue levels in vegetable samples (Sæthre et al., 2011).

Regulations governing the distribution and use of pesticides are in place in Benin (Présidence de la Republique du Benin, 1991), Ghana (Parliament of the Republic of Ghana, 1965, 1996) and Burkina Faso (Président du Faso, 1998a,b). In Benin, projects on integrated pest management and sustainable urban farming have targeted plant protection strategies in Cotonou and Porto Novo, respectively (James et al., 2006; RUAF Foundation, 2010). In Ghana, the Ministry of Agriculture and the World Bank (2008) have drafted the "Revised Food Safety Action Plan," and several institutions involving urban farmers have established projects that included training on integrated pest management, e.g. "From Seed to Table" (RUAF Foundation, 2010). Burkina Faso has taken action by adopting an integrated pest management program which cooperates with partners such as the Food and Agriculture Organization (FAO) to address various issues including plant protection in urban farming systems (Nacro, 2007, 2008).

In the absence of readily observable benefits to changing plant protection strategies, and without efficient governmental control mechanisms, urban vegetable production in the cities has remained in a state of systemic rigidity over the past years (Probst et al., 2012). Considering this situation, the question of how to improve chemical food safety places this research in the ongoing debate on the governance of food safety through public or private mechanisms (Henson and Reardon, 2005). In many countries (including those in the developing world), a shift from a single (public) standard to a multiple tier system has already taken place (Busch, 2011a,b). Private standards are disputed regarding questions of access to certified produce, democratic legitimacy and accountability (Hachez and Wouters, 2011). However, where public standards are not enforced, private standards may have the potential to contribute to food safety by stimulating market demand for produce posing lower health risks. One option to stimulate such demand is to increase quality differentiation by introducing certification and labeling of pesticide-free vegetables (Grunert, 2005; Poelman et al., 2008; Verbeke et al., 2007).

Certified organic production[1] and marketing provides such a "signal," based on a well-established and comprehensive system of guidelines ensuring a reduction of risk regarding agro-chemical contamination (Rembiałkowska, 2007). Certified organic production systems have more guaranteed contributions to chemical food safety than conventional production systems (Hansen et al., 2002), because most synthetic pesticides are excluded from organic production and post-harvest handling.

At present, organic production and marketing are not well-established in Benin, Ghana or Burkina Faso (Willer and Yussefi, 2006). Organic initiatives in these countries respond to overseas demand for premium tropical produce, and organic standards are implemented by European agencies to qualify producers and exporters for overseas markets. Consequently, domestic consumers do not benefit from the contributions of organic production systems to food safety.

Goal and research questions

Seeing in certified organic production and marketing a potential pathway to improve the chemical safety of food, and considering the increasing importance of "eating out" in urban West Africa, the overall goal of this study was to explore the potential for marketing certified organic vegetables in the food vending sectors of Cotonou, Accra and Ouagadougou.

This goal was translated into a sequence of research steps. Exploring the market, we first analyzed which vegetables are frequently processed and sold in food businesses. Assuming that perceived risk is a main factor in influencing buying behavior, we then assessed which of these vegetables were considered risk prone by both food vendors and consumers in terms of chemical and microbial contamination. To be able to draw conclusions about the marketing potential for certified organic vegetables in the food vending sector, we then used discrete choice experiments to investigate attributes that are important to (1) food vendors' choice of vegetables for their business and (2) consumers' choice of a vending spot and meal. Finally, the hypothetical attribute of "organic certification" was introduced and vendors' and consumers' willingness-to-pay (WTP) for organic certification was quantified.

Conceptual framework

Theoretically, the choice experiment in this study is rooted in concepts of consumer preference, stated choice elicitation and estimation of WTP for non-market goods.

The understanding of goods as a collection of attributes was introduced into consumer theory by Lancaster (1966). The Lancastrian approach posits that consumer choice (maximizing utility) is directed at combinations of product attributes rather than goods. This idea was taken further in the concept of the random utility theory (RUT), which understands utility as a latent construct underlying consumer choice (McFadden, 2001). According to RUT, the utility U of an alternative j can be described as the sum of observed (V) and unobserved components (ε) contributing to choice ($U_j = V_j + \varepsilon_j$). This approach, due to its flexibility, is widely used in consumer research in Sub-Saharan Africa and elsewhere (e.g. Bonabana-Wabbi and Taylor, 2008; Horna et al., 2005; Langyintuo et al., 2004; Masters and Sanogo, 2002; Minten, 2008).

In the case of vegetable markets in urban West Africa, quality differentiation by signaling organic production has yet to be introduced; consequently, market data based on revealed preferences are not available. Established methods to elicit stated preferences and WTP include contingent valuation (e.g. Diamond and Hausman, 1993), experimental auctions (e.g. De Groote et al., 2011) and discrete choice experiments. While experimental auctions are preferable as they most realistically model real market interactions, they are not possible for perishable vegetables and prepared food. Contingent valuation entails direct questions regarding the WTP for a hypothetical good, which has raised concerns on credibility, bias and precision of the responses (e.g. Diamond and Hausman, 1994). For this study, choice experiments were chosen to measure stated preferences since the method is consistent with RUT and allows for obtaining WTP data indirectly (Adamowicz et al., 1998). The validity of preference data and WTP estimates obtained by choice experiments is the subject of an on-going debate, but choice experiments generally allow for an adaptation of the elicitation process in order to minimize hypothetical bias (Hensher, 2010).

For understanding the influence of different attributes on a discrete dependent variable of choice, the multinomial logit model (MNL) (e.g. McFadden, 2001) provides a well-established possibility. The more recent mixed logit (ML) model (e.g. McFadden and Train, 2000; Train, 2009) relaxes key limitations of the MNL by accommodating for taste heterogeneity, shared variation across alternatives and repeated choices by individuals (Jaeger and Rose, 2008).

For the application of ML in a discrete choice experiment involving N respondents with J alternatives in T choice scenarios,

[1] We refer to IFOAM (2008, 2010) regarding the principles and standards of organic agriculture

consider utility to be specified as $U_{ntj} = \beta_n' x_{njt} + \varepsilon_{njt}$ where x_{njt} is a vector of observed attributes that relate to decision maker n, alternative j and choice scenario t; β_n' is a vector of coefficients of these variables specific to respondent n; and ε_{njt} is a random term that is independently and identically distributed extreme value.

As shown by Train (2009) and illustrated by Hole (2007), the probability of respondent n to choose alternative i in choice scenario t conditional on knowing β_n is

$$L_{nit}(\beta_n) = \frac{e^{\beta_n X_{nit}}}{\sum_j e^{\beta_n X_{njt}}} \quad (1)$$

In case of repeated choices by decision makers, the probability of the observed sequence of choices conditional on β_n is the product of logit formulas where $i(n,t)$ denotes the alternative chosen by decision maker n in choice scenario t:

$$S_n(\beta_n) = \prod_{t=1}^{T} L_{ni(n,t)_t}(\beta_n) \quad (2)$$

The probability unconditioned on the unknown β is the integral of this product over all values of β:

$$P_n(\theta) = \int S_n(\beta) f(\beta|\theta) d\beta \quad (3)$$

This probability is a weighted average of a product of logits evaluated at different values of β. The weights are given by β_n that are distributed with density $f(\beta|\theta)$. The parameters θ cannot be solved for analytically and are therefore approximated using simulated log likelihood.

As noted by McFadden (2001), exploring the potential for change in policy or marketing strategies often requires an estimation of WTP. We follow this concept, which is frequently applied in Sub-Saharan Africa in a variety of domains (e.g. Arimah, 1996; Danso, 2004; De Groote et al., 2011; Geneau et al., 2008; Jeuland et al., 2010; Onwujekwe, 2001).

Methods

Two separate questionnaires, including unlabeled discrete choice experiments, were developed to correspond with food vendors and consumers in each city. The first experiment involved vendors of ready-made food for urban dwellers and concerned the choice of fresh vegetables for food preparation (vendor experiment). The second experiment involved urban consumers of ready-made food and pertained to their choice of meals when eating out (consumer experiment). The sampling procedure, the development of the research instrument, data collection and the statistical analysis are explained in detail in the following subsections.

Study sites and sampling

The study was carried out in Cotonou (Benin), Accra (Ghana), and Ouagadougou (Burkina Faso). The cities were purposely selected as they represent the largest urban agglomerations and economic centers of each respective country (Ghana Districts, 2007; Institut National de la Statistique et de l'Analyse Economique, 2008; Institut National de la Statistique et de la Démographie, 2010; Obuobie et al., 2006). Moreover, by studying three cases, we increase the variance of social and economic background factors, such as nutritional habits, and governmental policies and regulations.

A stratified random sampling strategy (Bernard, 2006) was developed in order to address respondents from the population strata of street food vendors, small food businesses and restaurants in each of the three cities. Moreover, consumers frequenting these food vendors were interviewed.

Street food vendors were defined having non-permanent vending stands along streets, sometimes offering stools for seating. Small food businesses ("maquis", fast food outlets, chop bars) were defined as permanent installations, providing tables and seats in a sometimes roofed shelter. Restaurants were defined being located in permanent structures, offering a fixed menu and often table service.

To provide a sample broadly representative of the variety of the food vending sector in the cities, we purposely selected four zones based on criteria developed in cooperation with local partners. These include: (1) a city quarter where high class restaurants are concentrated, which are frequented by local and expatriate "elites;" (2) and (3) two different city quarters where restaurants, small food businesses and street food vendors coexist; and (4) a city quarter where street food vendors dominate, with only a few small food businesses and no restaurants (Table 1).

In each selected zone, the researchers passed through all navigable streets by foot or motorbike to note the positions of street food vendors, small food businesses and restaurants. From this sampling frame, vendors were randomly selected to meet the predefined quotas (Table 1).[2] Vendors unwilling to participate were replaced with a respondent from the same quarter and business category.

In each surveyed food business, and with the vendors' consent, we approached consumers in clockwise order, interviewing the first two individuals met who had eaten in a food vending business at least five times before in 2009.

Research instrument

Two separate questionnaires were developed to correspond with food vendors and consumers in each city. The questionnaires focused on four areas of variation: (1) individual socio-demographic data; (2) choice experiment; (3) knowledge of vegetable contamination risks; and (4) characteristics of the food business (vendors), or consumption habits (consumers).

Once respondents had answered the questions on socio-demographic data, they were asked whether they were aware of organic agriculture. A follow up question to define organic agriculture was asked to respondents who had responded positively. Then, the choice experiment was explained and the following simplified definition was read to the respondent: *"Organic vegetable production does not use synthetic pesticides and seeks to produce vegetables in a natural way."*

Based on this common understanding of organic production, researchers asked the respondent to imagine either buying vegetables in the market (vendors) or eating out (consumers). Each respondent then completed a choice experiment evaluating six choice situations with three options of the type represented in Figs. 1 and 2. Respondents' comments rationalizing their choices were recorded.

After having completed the choice experiment, unranked free-listing exercises were conducted to address vegetable use (vendors) and risk perception (vendors and consumers). Finally, respondents provided more detailed information on the food vending business (vendors) or budget and consumption habits (consumers).

We pre-tested the questionnaires and choice experiments in Cotonou with ten vendors and ten consumers as a means to improve the final design of the research instrument.

[2] In Cotonou and Accra, researchers deviated from the symmetric quotas when noticing that some street food vendors could also be found in the city quarter with high class restaurants.

Table 1
Research zones and sample frame.

City	Zone	Quarter	Street food vendors		Small food business		Restaurant	
			Vendor	Consumer	Vendor	Consumer	Vendor	Consumer
Cotonou	1	Cadjèhoun	2	4	5	10	10	20
	2	St. Michel	4	8	5	10	5	10
	3	Kouhounou	4	8	5	10	5	10
	4	Akpakpa	10	20	5	10	0	0
		Subtotal	20	40	20	40	20	40
Accra	1	Osu	2	4	5	10	10	20
	2	Legon	5	10	5	10	5	10
	3	Achimota	5	10	5	10	5	10
	4	Korle Bu	8	16	5	10	0	0
		Subtotal	20	40	20	40	20	40
Ouagadougou	1	Centre ville	0	0	5	10	10	20
	2	Zogona	5	10	5	10	5	10
	3	Patte d'Oie	5	10	5	10	5	10
	4	Secteur 27	10	20	5	10	0	0
		Subtotal	20	40	20	40	20	40
		n total	60	120	60	120	60	120

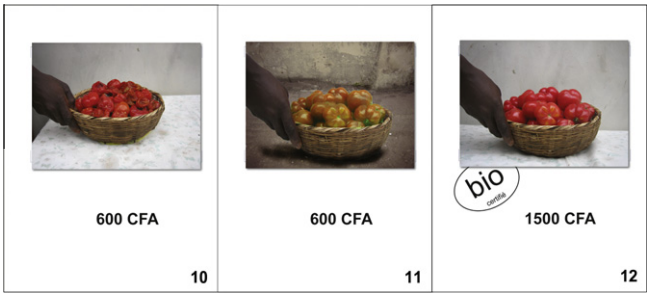

Fig. 1. Vendor choice experiment – scenario example (Ouagadougou).

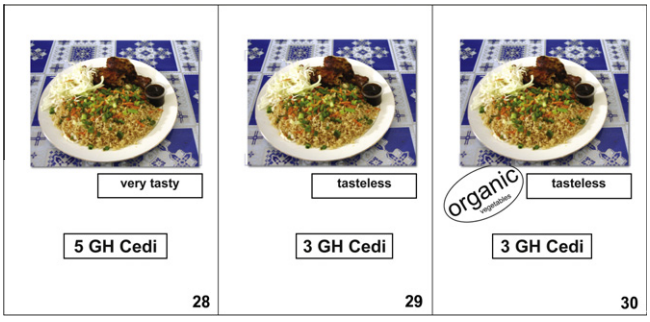

Fig. 2. Consumer choice experiment – scenario example (Accra).

The questionnaires were developed in English and French. The interviews were conducted in French and Fon (Cotonou); English, Twi and Ga (Accra); and French and Mòoré (Ouagadougou). Field staff in each city comprised the first author and a local researcher who discussed translations of core concepts in detail to maximize consistency. Data collection activities spanned the period from September to December 2009.

Choice experiment

As explained, separate discrete choice experiments were conducted with vendors and consumers in order to understand the influence of different attributes on a discrete dependent variable of choice. Basically, a discrete choice experiment exposes respondents to a hypothetical buying decision with several options. Based on the attributes represented (stimuli of different kinds, e.g. color), the respondents were asked to decide which of the three options they would choose when buying vegetables in the market (vendor experiment) or eating out (consumer experiment) (see Figs. 1 and 2). The attribute levels within and across choice situations were varied systematically (see experimental design). Relating respondents' choices to attribute levels allows for development of a ML model to understand the influence of different attributes on a variable of choice.

Choice experiment: attributes and attribute levels

The initial step to develop a choice experiment is to identify relevant attributes and to decide on attribute levels. Following Jaeger and Rose (2008), we decided: (1) to use a vegetable (vendor experiment) and meals (consumer experiment) that are subject to frequent real life choices; (2) to define attribute levels that reflect previous methodological and empirical suggestions and are accepted as realistic by respondents.

Accordingly, fresh tomatoes were chosen for the vendor experiment given that they are widely used for the preparation of a variety of meals in food businesses of all classes in all cities. For the consumer experiment, in each city we selected a "continental" dish and a "traditional" dish and prepared identical choice sets for the two cases. This was done to make choice situations more realistic by using choice sets corresponding to the type of food served in food establishments (Table 2).

The selection of attributes and attribute levels for the vendor choice experiment (Table 3) was informed by previous research on vegetable preferences in the region (Amadou, 2008; Nouhoheflin et al., 2004; Ouedraogo, 2009; Probst et al., 2010) and market observations.

Similarly, attributes and attribute levels for the consumer experiment were selected based on the literature (Rheinländer et al., 2008) and on observations in the three cities (Table 4). The final design included the attributes PRICE, TASTE and ORGANIC which proved to be statistically significant when modeling the pre-test choices.

In order to keep the choice task simple, a non-choice option was not given in either experiment. Following Train (2009), this limits the validity of the results to buying behavior in a specific market setting (vendors) and to eating out situations (consumers).

Table 2
Stimulus representation in vendor and consumer experiment.

Vendor experiment	*All study sites*		
Stimulus representation: Photo	Basket of tomatoes, containing 3 kg		
Consumer experiment	*Benin*	*Ghana*	*Burkina Faso*
Stimulus representation: Photo of "continental dish"	Rice, vegetable sauce, fried chicken	Fried rice, vegetable siding, fried chicken	Rice, tomato sauce, goat meat
Stimulus representation: Photo of "traditional dish"	Pâte blanche[a], vegetable sauce, chicken	Banku[b], vegetable soup, fish	Benga[c] with vegetables and goat meat

[a] Thick porridge of cooked maize flour.
[b] Balls of cooked, soured maize flour.
[c] Cooked beans.

Table 3
Experimental design factors and levels – food vendors.

Attribute	Level	Attribute level wording: Benin/Burkina Faso	Attribute level wording: Ghana
[PRICE] Price of basket[a]	1	300 FCFA (*0.64 USD*)	1 GHS (*0.71 USD*)
	2	600 FCFA (*1.27 USD*)	2 GHS (*1.41 USD*)
	3	900 FCFA (*1.91 USD*)	3 GHS (*2.13 USD*)
	4	1500 FCFA (*3.18 USD*)	5 GHS (*3.55 USD*)
[APPEAR] Appearance of vegetables	1	Basket of tomatoes, degraded	
	2	Basket of tomatoes, fresh	
[COLOR] Color of vegetables [b]	1	Basket of tomatoes, partly green	
	2	Basket of tomatoes, full red	
[NEAT] Neatness of vegetables	1	Basket of tomatoes, dusty and on the ground	
	2	Basket of tomatoes, clean and on a table	
[ORGANIC] How vegetables were grown	1	(Not organic)	
	2	Certified organic	

[a] Conversion rates based on period average for 2009 (IMF 2010).
[b] Original photos were manipulated using Photoshop CS3 to obtain partly green fruit colors. In each case, the fruit area of the image was selected and RGB values changed as follows: R −25, G +40, B −25.

Table 4
Experimental design factors and levels – consumers.

Attribute	Level	Attribute level wording: Benin/Burkina Faso	Attribute level wording: Ghana
[PRICE] Price of meal[a]	1	200 FCFA (*0.42 USD*)	1 GHS (*0.71 USD*)
	2	500 FCFA (*1.06 USD*)	2 GHS (*1.41 USD*)
	3	800 FCFA (*1.69 USD*)	3 GHS (*2.13 USD*)
	4	1100 FCFA (*2.33 USD*)	5 GHS (*3.55 USD*)
[TASTE] Taste of meal	1	Tasteless	
	2	Very tasty	
[ORGANIC] How vegetables added to the meal were grown	1	(Not organic)	
	2	Certified organic vegetables	

[a] Conversion rates based on period average for 2009; (IMF 2010).

Choice experiment: experimental design

The experimental design of a stated choice experiment entails the systematic and planned allocation of attributes and attribute levels to choice situations. An efficient design aims at minimizing standard errors of choice model parameter estimates during the design stage. This is possible by using prior information on probable parameter values to construct the asymptotic variance–covariance (AVC) matrix of different designs which can be evaluated for statistical efficiency (see Rose et al., 2008 for a comprehensive explanation of designing efficient stated choice experiments).

For this study, Bayesian efficient designs were generated using the Ngene software (Ngene 1.0, 2009). Bayesian efficient designs allow taking into account uncertainty about the true value of priors used to construct the AVC matrix. In accordance with Jaeger and Rose (2008), we used Halton sequences (50) for the analytical determination of the AVC matrix in Ngene. In the vendor experiment, the priors necessary for generating the Bayesian efficient design were based on information from the literature (Amadou, 2008; Nouhoheflin et al., 2004; Probst et al., 2010; van der Pol and Ryan, 1996). For the final design, the priors were readapted according to the model results of the pre-test experiment. In the consumer experiment, we applied a design with zero priors in the pre-test and used the model results for obtaining the final efficient design. ChoiceMetrics (2009) provide a detailed review of the theory and practice of generating efficient designs using Ngene.

As proposed by Huber and Zwerina (1996), we used the D_p-*error* as a theoretically appropriate measure for evaluating design efficiency. The D_p-*error* is the determinant of the AVC matrix scaled for the number of parameters, and a design with lower D_p-*error* also shows lower (co)variances of the parameter estimates (Rose

et al., 2008). Considering that organic production and marketing are more costly, the design in both cases was conditioned so that the PRICE attribute could take the highest levels 3 or 4 only if the ORGANIC attribute took level 2.

The final designs consisted of twelve choice situations for vendors (vendor experiment) and of twelve choice situations for consumers (consumer experiment). For each group of respondents, the choice situations were randomly grouped into two subsets of six choice situations (vendor subset A/B and consumer subset A/B). Vendors interviewed were randomly allotted to vendor subset A or B and consumers interviewed were randomly allotted to consumer subset A or B. By completing a subset, each respondent had to select the preferred option amongst three possible choices in six choice situations.

Figs. 1 and 2 show examples of choice sets and how attribute levels were translated into stimuli.

Statistical analysis and empirical model

The collected data was input into Excel spreadsheets and analyzed using STATA (v.11) and PASW statistics (v.18).

Group differences were explored regarding vegetable use and risk perception using Chi-square tests (applying the Holm adjustment in case of multiple testing).

For the empirical realization of the general model, consider a mixed logit of (1) vendors' choices of fresh tomatoes and (2) of consumers' choices of meals when eating out. Utility is $U_{ntj} = \beta'_n x_{njt} + \varepsilon_{njt}$ and β_n varies over respondents. The attributes specified in Tables 3 and 4 enter the estimation as elements of x in the respective models. The *mixlogit* (Hole, 2007) procedure in STATA was used to estimate the models. *Mixlogit* allows normal (N) and lognormal (LN) distributions of coefficients; based on pre-tests, we did not expect coefficients to have the same sign for all respondents, and therefore assumed normal distributions (Train, 2009). For simulation, 200 Halton draws were used.

Reflecting on the research interest in the ORGANIC attribute and in order to better understand how preference varies across subjects, ORGANIC was interacted with selected demographic variables in extended models (Tables 7 and 8).

In fixed-coefficient models, the WTP for an attribute is calculated as the ratio of the attribute coefficient to the price coefficient. However, calculating the ratio of two normally distributed mixing distributions does not yield a well-specified distribution (Hole and Kolstad, 2010; Richatsch, 2009). Therefore, Richatsch (2009) was followed in simulating WTP values by drawing random numbers from the parameter mixing distributions (defined to be N). WTP was then estimated by using the attribute-to-price ratio of the drawn distributions.

Results

The results section summarizes the characteristics of respondents and presents which vegetables are frequently used in food businesses as well as which vegetables are considered risk prone by food vendors and consumers. Lastly, before the WTP for organic certification is quantified, attributes relevant to vendors' and consumers' choices are discussed based on the discrete choice experiment.

Characteristics of respondents

Table 5 shows that food provision in the eating out sector is a predominantly female domain, with vendors having on average eight years of experience in the business. The level of formal education varied from "never been to school" to "post-secondary", with a clear majority being educated up to middle school. The main sources of information among food vendors were television and radio. The awareness of microbial contamination of vegetables was slightly higher in Cotonou and Ouagadougou than in Accra, while awareness of possible chemical contamination was much higher in Accra than in the other cities. In Cotonou and Accra, 21.7% of respondents could give a relatively accurate definition of organic agriculture, compared to only 8.3% in Ouagadougou. Concerning the input cost share of vegetables, we calculated an average of 22% per plate based on food vendors' estimations.

Consumer characteristics are summarized in Table 6. In contrast to vendors, the typical consumer was male and about 32 years old. Regarding education, between 40% (Ouagadougou) and 52.5% (Cotonou) of consumers had post-secondary education. Their main sources of information were TV and radio; however, the internet is gaining importance particularly in Accra. The weekly budget spent on prepared food varied between a median of $9.94 in Accra and a median of $22.24 in Cotonou. Stated monthly income as sum of wage and any other revenues varied between a median of $156.16 (Accra) and a median of $317.67 (Cotonou). Similar to the food vendors, consumers in Cotonou and Ouagadougou were more aware of microbial contamination of vegetables than in Accra, while awareness of possible chemical contamination was again much higher in Accra than in the other cities. On average, 31.67% of consumers were able to give a relatively accurate definition of organic vegetable production.

Which vegetables are frequently used in food businesses?

Fig. 3 presents the results of an unranked free-listing exercise conducted with food vendors; the respondents were asked to list the three vegetables they most frequently use in food preparation.

Table 5
Food vendors – summary of sample characteristics.

Variable	Category	Cotonou (N = 60)	Accra (N = 60)	Ouagadougou (N = 60)	Overall (N = 180)
Age (years: mean/Std.Dev.)		35.98/8.54	37.45/10.29	32.40/9.60	35.28/9.69
Female (%)		75.0	76.7	68.3	73.3
Education (%)	Never been to school	30.0	16.7	23.3	23.3
	Primary school	26.7	3.3	23.3	17.8
	Middle school	16.7	33.3	23.3	24.4
	Secondary school	21.7	21.7	20.0	21.1
	Post-secondary education	5.0	25.0	10.0	13.3
Experience in food vending (years: mean/Std.Dev.)		10.31/6.96	9.83/8.01	5.171/4.95	8.437/7.12
Preferred media (%)	TV	66.7	43.3	30.0	46.7
	Radio	28.3	50.0	60.0	46.1
	Newspapers	1.7	1.7	3.3	2.2
	Internet	3.3	5.0	6.7	5.0
Vegetable cost share/plate (%: mean/Std. Dev.)		18.12/11.23	29.11/14.93	20.95/12.98	22.10/13.59
Awareness (%)	Chemical contamination	8.3	45.0	3.3	18.9
	Microbial contamination	68.3	60.0	71.7	66.7
	Organic vegetable production	21.7	21.7	8.3	17.2

Table 6
Consumers – summary of sample characteristics.

Variable	Category	Cotonou (N = 120)	Accra (N = 120)	Ouagadougou (N = 120)	overall (N = 360)
Age (years: mean /Std. dev.)		36.5/9.317	30.492/10.519	30.658/8.026	32.55/9.728
Female (%)		21.67	38.33	15.83	25.28
Education (%)	Never been to school	3.33	5.0	11.67	6.67
	Primary school	16.67	3.33	10.0	10.0
	Middle school	13.33	16.67	17.5	15.83
	Secondary school	14.17	25.0	20.83	20.0
	Post-secondary education	52.5	50.0	40.0	47.5
Preferred media (%)	TV	60.0	32.5	33.33	41.94
	Radio	27.5	35.0	48.33	36.94
	Newspapers	2.5	3.33	4.17	3.33
	Internet	10.0	29.17	14.17	17.78
Weekly budget spent on 'eating out' (USD: median)		22.237	9.938	10.165	12.422
Monthly income (USD: median)		317.671	156.161	158.836	211.781
Awareness (%)	Chemical contamination	25.0	48.33	10.0	29.72
	Microbial contamination	70.0	46.67	67.5	61.39
	Organic vegetable production	37.5	29.17	28.33	31.67

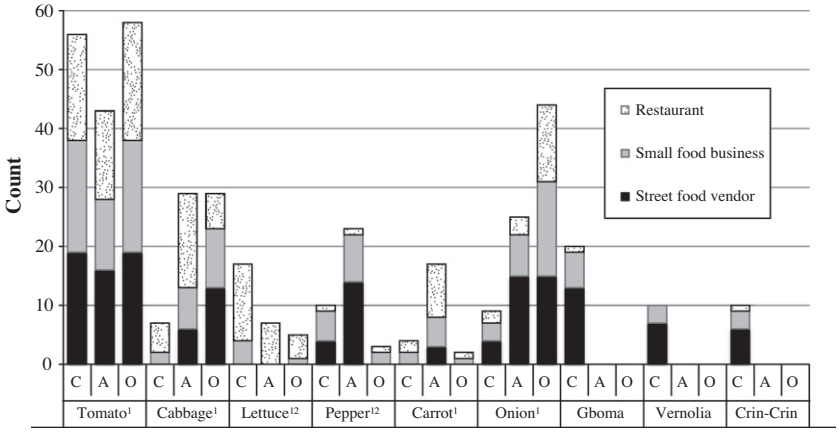

Fig. 3. Vegetables used in food businesses. C - Cotonou, A - Accra, O - Ouagadougou; [1]significant difference between cities ($p < 0.05$); [2]significant difference between types of food business

Pearson Chi-square tests, using the Holm adjustment for multiple testing, were applied to explore differences between cities or between types of food businesses regarding the use of vegetables. Tomato, cabbage and onion were found to be the main vegetable ingredients of prepared food in the three cities.

In Cotonou, cabbage is used significantly less than in the other cities while lettuce (mostly in restaurants) is used more often. The traditional leafy vegetables gboma[3], vernonia and crin–crin were mentioned only in Cotonou, mainly by street food vendors.

In Accra, tomatoes are used significantly less than in the other cities. In contrast, pepper (in soups) and carrots (in fried rice) are used more often. Cabbage (as coleslaw) is a standard side dish in restaurants.

In Ouagadougou, pepper and carrot do not play an important role; however, onions are frequently used in food businesses of all categories.

Which vegetable is considered risk prone for what reason?

A similar unranked free-listing exercise was conducted with food vendors and consumers to investigate which vegetables are considered to pose health risks (Fig. 4). The respondents were again asked to list three vegetables. Counts were normalized to percentages in order to allow for comparison between vendors and consumers. Pearson Chi-square tests (using the Holm adjustment for multiple testing) were applied to explore differences between cities and to identify associations between a respondent being aware of chemical or microbial contamination and considering a crop risk prone.

We found that mainly tomatoes, cabbage and lettuce are considered risk prone by vendors and consumers alike. There is a statistically significant difference between cities in regards to risk perception as apparent in Fig. 4. Moreover, testing underlined that respondents who were aware of chemical contamination of vegetables considered cabbage ($\chi^2 = 26.864$; $p = 0.000$) and garden eggs ($\chi^2 = 8.851$; $p = 0.015$) to be risk prone significantly more often. Respondents who were aware of microbial contamination listed lettuce as a risk prone vegetable more often ($\chi^2 = 10.453$; $p = 0.006$).

What are attributes relevant to vendors' and consumers' choice?

Vendor models – choice of vegetables

Model 1 (Table 7) presents the results of an estimation of the vendor choice experiment which include the main effects only. All five attributes entering the estimation proved to be significant (PRICE, APPEAR, COLOR, NEAT, ORGANIC). As expected, the parameter estimate for PRICE (i.e. price level of a basket of fresh

[3] Gboma: (*Solanum macrocarpum*; Vernonia*: Vernonia amygdalina*; Crin-crin*: Corchorus olitorius*.

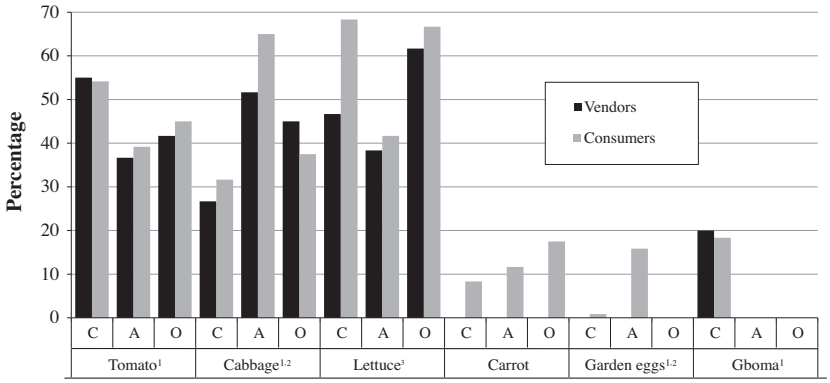

Fig. 4. Vegetables considered risk prone by food vendors and consumers. C – Cotonou, A – Accra, O – Ouagadougou; [1]significant difference between cities ($p < 0.05$); [2]significant association between awareness of chemical contamination and considering this crop risk prone ($p < 0.05$); [3]significant association between awareness of microbial contamination and considering this crop risk prone ($p < 0.05$)

Table 7
Vendors – Summary of Models 1 and 2.

		Model 1		Model 2	
		Mean (*p*-value)	Std Dev (*p*-value)	Mean (*p*-value)	Std Dev (*p*-value)
Parameters	PRICE	−0.508 (*0.000*)	0.988 (*0.000*)	−0.525 (*0.000*)	1.063 (*0.000*)
	APPEAR	3.622 (*0.000*)	2.312 (*0.000*)	3.970 (*0.000*)	2.618 (*0.000*)
	COLOR	1.633 (*0.000*)	1.277 (*0.000*)	1.756 (*0.000*)	1.433 (*0.000*)
	NEAT	0.604 (*0.000*)	0.719 (*0.051*)	0.680 (*0.000*)	0.917 (*0.000*)
	ORGANIC	1.639 (*0.000*)	1.715 (*0.000*)	2.419 (*0.033*)	1.583 (*0.000*)
Interactions					
ORGANIC	× ACCRA			1.729 (*0.004*)	
	× OUAGADOUGOU			1.312 (*0.008*)	
	× SMALL BUSINESS			−0.836 (*0.100*)	
	× RESTAURANT			−1.465 (*0.018*)	
	× AGE			−0.047 (*0.070*)	
	× SEX			−0.628 (*0.228*)	
	× PRIMARY SCHOOL			0.071 (*0.908*)	
	× MIDDLE SCHOOL			1.876 (*0.003*)	
	× SECOND. EDUCATION			1.204 (*0.072*)	
	× POST-SECOND. EDUCATION			0.221 (*0.804*)	
	× EXPERIENCE			0.056 (*0.133*)	
	× AWARENESS ORGANIC PRODUCTION			0.794 (*0.179*)	
	× AWARENESS CHEM. CONTAMINATION			−0.233 (*0.721*)	
Log-likelihood		−743.227		−722.161	
Number of observations		3240		3240	
LR test of significance of all coefficients		131.18 ($p = 0.000$)		119.08 ($p = 0.000$)	
LR test of improvement in model fit of model 2 relative to model 1				42.13 ($p = 0.000$)	

tomatoes) was negative. On average, the more expensive a basket of tomatoes was, the less likely it was to be chosen ($\beta_{\text{PRICE-mean}} = -0.508$; $p < 0.000$). However, the standard deviation parameter estimate is of higher magnitude than the mean, showing that some respondents associated positive utility with higher prices ($\beta_{\text{PRICE-Stdev}} = 0.988$; $p < 0.000$). Contradicting mainstream economic hypotheses, this suggests that the perceived "price-quality" link is deeply ingrained and resists unfamiliar choice situations. The parameter estimate for APPEAR (i.e. fresh appearance of tomatoes) was positive, underlining the key role of outer appearance for assessing the quality of vegetables ($\beta_{\text{APPEAR-mean}} = 3.622$; $p < 0.000$). The COLOR (i.e. whether tomatoes were fully red or partly green) parameter estimate was significantly positive, demonstrating that on average food vendors prefer ripe tomatoes. Neatness of presentation (NEAT) was considered less important, and the magnitude of the standard deviation estimate ($\beta_{\text{NEAT-Stdev}} = 0.719$; $p < 0.000$) illustrates that some respondents assign no utility to neatness. For the hypothetical attribute of organic certification (ORGANIC), the estimated parameter mean was positive ($\beta_{\text{ORGANIC-mean}} = 1.639$; $p < 0.000$), indicating a basically positive perception of the utility of organic products. The large standard deviation ($\beta_{\text{ORGANIC-Stdev}} = 1.715$; $p < 0.000$) underlines the individual differences in assigned utility.

In Model 2 (Table 7), thirteen additional fixed interaction effects with the ORGANIC attribute were established to explore possible socio-demographic influences on the perceived utility of organic certification. All effects significant in Model 1 remained and model fit was significantly improved.

The parameter estimates for ORGANIC × ACCRA and ORGANIC × OUAGADOUGOU suggest that organic certification has a significantly higher influence on choice in these two cities compared to in Cotonou. The interaction effects between ORGANIC

and type of food vending business show that compared to street food vendors, choosing organic alternatives is less likely for small food businesses and significantly less likely in restaurants. The qualitative data recorded suggest that staff of formal food businesses associate natural production with lower quality, particularly in terms of shelf life and outer appearance. In contrast, street food vendors and staff of small food businesses stated that they would process purchased vegetables immediately, so shelf life or appearance were considered less important.

The effect of ORGANIC × AGE was low in magnitude and not significant with a negative sign. The ORGANIC × SEX term was not significant, suggesting that a preference for organic certification is not associated to gender.

Compared to respondents without formal education, respondents with middle or secondary school education associated higher utility with organic certification. For respondents with post-secondary education, this effect could not be shown.

The awareness variables expected to be positively associated with choosing certified vegetables (awareness of organic vegetable production and of chemical contamination of vegetables) showed no significant influence when interacting with ORGANIC.

Consumer models – choice of meals

Models 3 and 4, based on unlabeled choice experiments with consumers in food vending businesses, are summarized in Table 8.

Model 3 included the main effects of the basic experimental design attributes (PRICE, TASTE, ORGANIC). All three attributes were statistically significant ($p < 0.000$) in the mean values and standard deviations, PRICE with negative parameter sign, TASTE and ORGANIC with positive parameter sign. These results suggest that consumers on average prefer cheaper meals, but the high magnitude of standard deviation shows that for some consumers, price plays a minor role and has little or no negative utility. Both TASTE and ORGANIC have positive parameter signs, and again the standard deviations point to significant heterogeneity of the respective utilities in the sample.

Similar to the vendor model, fourteen additional fixed interaction effects with the ORGANIC attribute were established to analyze socio-demographic influences on the utility of organic certification. The model fit was significantly improved compared to Model 3 ($p = 0.000$). The PRICE and TASTE parameters remained significant, but ORGANIC was not significant as a main effect in Model 4.

As in the vendor model, the parameter estimates for ORGANIC × ACCRA and ORGANIC × OUAGADOUGOU had positive signs and were significant ($p < 0.000$), underlining that in the two cities, organic certification has a more positive influence on choice than in Cotonou.

In contrast to the vendor model, the estimation results suggest a positive association between ORGANIC and the characteristics "consumer in small business" (not significant at the 5% level) as well as "consumer in restaurant" ($p < 0.000$).

The ORGANIC × SEX and ORGANIC × AGE interaction terms were not significant, demonstrating that organic certification does not have significantly different effects on choice in different groups of sex or age, respectively; interacting ORGANIC with different educational levels, however, showed that respondents with formal education associated a significantly higher utility with organic certification. Interacting ORGANIC with monthly income did not yield a significant effect, and neither did interacting the awareness variables (awareness of organic vegetable production and of chemical contamination of vegetables) with ORGANIC.

To control possible influences of the different meals used as stimulus in the experiment on consumers' preference for ORGANIC, a variable SET was interacted with ORGANIC; however, a systematic influence was not identified.

Vendors' and consumers' willingness to pay (WTP) for organic certification

Estimating WTP based on preference data is a possibility for monetary valuation of nonmarket goods. We applied an estimation based on the main-effects mixed logit model, using random draws from the mixing distributions of PRICE and ORGANIC. Table 9 summarizes the results for vendors and consumers using the median, which is more robust to outliers.

Table 8
Consumers – Summary of Models 3 and 4.

		Model 3		Model 4	
		Mean (*p*-value)	Std Dev (*p*-value)	Mean (*p*-value)	Std Dev (*p*-value)
Parameters	PRICE	−1.971 (*0.000*)	2.075 (*0.000*)	−1.964 (*0.000*)	2.083(*0.000*)
	TASTE	2.953 (*0.000*)	2.060 (*0.000*)	2.954 (*0.000*)	2.061 (*0.000*)
	ORGANIC	3.300 (*0.000*)	1.993 (*0.000*)	0.912 (*0.304*)	1.670 (*0.000*)
Interactions					
ORGANIC	× ACCRA			1.612 (*0.000*)	
	× OUAGADOUGOU			1.480 (*0.000*)	
	× SMALL BUSINESS			0.576 (*0.097*)	
	× RESTAURANT			1.041 (*0.015*)	
	× AGE			0.034 (*0.047*)	
	× SEX			−0.088 (*0.678*)	
	× INCOME			−0.001 (0.061)	
	× PRIMARY SCHOOL			1.245 (*0.043*)	
	× MIDDLE SCHOOL			2.397 (*0.000*)	
	× SECOND. EDUCATION			2.400 (*0.001*)	
	× POST-SECOND. EDUCATION			1.781 (*0.002*)	
	× AWARENESS ORGANIC PRODUCTION			0.068 (*0.678*)	
	× AWARENESS CHEM. CONTAMINATION			0.140 (*0.690*)	
	× SET			−0.041 (*0.758*)	
Log-likelihood		−1398.425		−1396.248	
Number of observations		6300[a]		6300	
LR test of significance of all coefficients		328.10 ($p = 0.000$)		291.78 ($p = 0.000$)	
LR test of improvement in model fit model 4 relative to model 3				58.35 ($p = 0.000$)	

[a] Missing cases in interaction variables excluded from model estimation.

Table 9
WTP vendors and consumers.

	Vendor experiment Random draws (10^6)	Consumer experiment Random draws (10^6)
Median USD[a]	0.848	1.044
% premium on largest price in the experiment		
Benin, Burkina Faso	26.7	44.8
Ghana	23.9	29.4
% premium on typical retail price[b] [3 kg basket of conventional tomatoes]		
Benin (lean/peak season)[c]	16.0/39.9	
Burkina Faso (lean/peak season)	26.7/53.4	
Ghana (lean/peak season)	12.10/23.9	
% premium on average meal price in sample		
Street food vendor		176.9
Small food business		75.2
Restaurant		19.1

[a] Conversion rates based on period average for 2009 (IMF, 2010).
[b] Calculation based on market observations in the three cities.
[c] The tomato market fluctuates strongly with cropping seasons (Ihle and Amikuzuno, 2010).

The median WTP of vendors was estimated to be \$0.848 for organic certification of the fresh tomatoes presented as stimulus in the vendor experiment. This corresponds to a premium between 23.9% (relating to the largest experimental price/Ghana) and 26.7% (relating to the largest experimental price in Benin/Burkina Faso). Relating the median WTP to typical market prices results in an estimated premium between 12.1–23.9% (Ghana), 16.0–39.9% (Benin) and 26.7–53.4% (Burkina Faso) depending on the season (Table 9).

The estimates for the consumer experiment showed the median WTP for organic certification of vegetables used to prepare a plate to be \$1.044 per plate. This corresponds to a premium between 29.4% (relating to the largest experimental price/Ghana) and 44.8% (relating to the largest experimental price in Benin/Burkina Faso). Relating the median WTP to average meal prices recorded in the survey results in a premium between 19.1% (restaurant) and 176.9% (street food vendors).

Discussion

Setting priorities for intervention: use of vegetables and risk awareness

Reflecting on the findings on varieties of vegetables used in food businesses, we propose focusing interventions on improving the chemical safety of tomatoes, cabbage and lettuce. Although systematically recorded disaggregate data are not available, tomato is visibly the vegetable used most in the three cities. Cabbage pests are difficult to control in the West African context (James et al., 2010), so high contamination levels can be assumed. Lettuce, which is consumed raw, does not benefit from the partial heat breakdown of pesticides in contrast to vegetables used in soups or stews, such as tomatoes (Abou-Arab, 1999).

Generally, a baseline study at the market level in the three cities, analyzing different vegetables regarding pesticide residue levels, would be of the utmost importance. The information currently available on actual exposure risk is patchy and neither stimulates action by policy makers nor eases concerns raised by researchers in the field. Moreover, continuous recording of vegetable consumption in the cities is an important step to allow for reliable risk assessment; again, this would help to direct action aimed at change towards safer and more sustainable plant protection practices.

Risk awareness regarding both chemical and microbial contamination showed clear differences between the cities, most likely caused by different educational campaigns in the respective countries. We hypothesized that awareness of chemical contamination would be a strong factor in influencing the choice of certified organic vegetables. However, both the vendor and the consumer model showed that neither awareness of chemical contamination nor prior knowledge of organic farming practices had such a significant effect. This finding is in agreement with Karg et al. (2010), who state that awareness alone is not a driver of behavioral change.

However, low awareness of health risks related to agro-chemical contamination was identified before as a major constraint for establishing quality differentiation in the vegetable market in urban West Africa (Danso, 2004; Probst et al., 2010; Coulibaly et al., 2011). Our results underline the difficulties in the domestic market for organic food in West Africa, characterized by a general lack of knowledge about the nature and benefits of organic agriculture. Therefore, and considering that "organic" is a credence attribute per se, awareness creation and education will be a necessary component of interventions for a change towards safer and more sustainable production.

Marketing potentials for organic vegetables in the food vending sector

The discrete choice models provide some information to single out target groups for certified organic vegetables. Surprisingly, vendors in higher class categories associated lower utility with produce labeled organic. In contrast to street food vendors and staff of small food businesses, restaurateurs stated that they prefer chemically treated vegetables because they assume treatment to be associated with better appearance and a longer shelf life. An additional explanation of the difference between vendor categories could be that in lower class businesses, the respondents' grasp of the concept of organic certification and marketing may have been particularly weak.

The relatively lower utility attributed to organic certification by restaurateurs is in contrast to the preferences of "elite" consumers with higher education, who associated meals prepared using organic vegetable with relatively higher utility. The association of education and preference for certified food has been identified in numerous studies (e.g. Batte et al., 2007; Haas et al., 2010; Huang et al., 1999; Posri et al., 2006; Roitner-Schobesberger et al., 2008).

We propose two explanations for the contrast between "elite" vendors and "elite" consumers: first, consumers with higher education may understand that it is socially desirable to state a preference for certified organic vegetables, whereas restaurant vendors know that actual demand is for better appearance, particularly concerning vegetables served raw; second, food vendors may not

be aware that the health value of ingredients could be of added value to their customers.

From a marketing point of view, this situation is challenging – a clearly defined and ready market does not exist in the food vending sector. If certified vegetables are to play a role in the food vending sector in the future, we suggest limiting efforts to the target group of highly educated consumers and food businesses frequented by this group. Here, the WTP for organic certification found in this research would be clearly within the range of price premiums identified by other studies. Although evidence from developing countries is limited, the review by Yirdidoe et al. (2005) suggests an average WTP premium for organic certification of about 30%. This is in accordance with Hammitt's (1993) study on the willingness to pay to avoid pesticide residues (36% premium) and the research by Akgüngör et al. (2010) on organic tomatoes in Turkey (36% premium). Focusing on private households in urban Ghana and Benin, Coulibaly et al. (2011) calculate a premium for organic certification of 57–66% for cabbage and 50–56% for tomatoes.

Also, the importance of search attributes (e.g. appearance, color) for food vendors buying vegetables shows that certified organic produce will need to provide the same search cues as conventional vegetables. Moreover, it will be necessary to take into account the complexity and cost of marketing a certified product in the food vending sector (CORE Organic, 2009). An intervention towards facilitating organic production and marketing will also be less likely to fail in Accra and Ouagadougou, where respondents associated higher utility with organic certification. Furthermore, we suggest communicating "eating organic" as a desirable, modern behavior. Recent examples for status related marketing successes include fresh, cooled fruit juices in Accra (Ross, 2009), high end mobile phones in all cities, and specific motorbike brands in Ouagadougou and Cotonou.

In light of the challenging market situation, we believe that the market alone will not develop mechanisms necessary for reliable certification of such produce. Such reliable certification is the precondition for turning the credence attribute of "freedom from pesticide residue" into the search attribute "organically labeled." Therefore, the public commitment of policy makers to provide supportive mechanisms for an innovation of the vegetable value chain is a necessary driver of change.

Discrete choice experiments in "no choice" markets in urban West Africa

Critical impediments to obtaining balanced results in the discrete choice experiment were the social desirability of answers and hypothetical bias. These concerns are frequently raised regarding the use of stated preference methods for analyzing choice behavior (e.g. Jaeger and Rose, 2008; Hensher, 2010). During data collection for this study, social desirability was encountered when respondents asked the researcher which the right answer was, or when respondents tried to meet assumed expectations of the researcher. Moreover, hypothetical bias occurred when respondents answered the question of what they *would like to* buy rather than what their *actual* choice in a market situation would be. Recently, suggestions have been made to reduce such effects by asking what other people would be likely to choose (e.g. Lusk and Norwood, 2010). However, for a marketing study this poses the problem that choice data would not relate to specific respondents.

Based on field experience, it must be assumed that the effects of social desirability and hypothetical bias affect the results. Although we consider a premium of 30% as realistic based on the literature, previous studies present varying calculations of premiums for organic certification of food (15–103% premium; see: Ara, 2003; Batte et al., 2007; Kim et al., 2008; Lin et al., 2008; Millock and Hansen, 2002; Sanjuán et al., 2003; Van Loo et al., 2011). This suggests regional differences of WTP, variance of WTP regarding different foods and underlines the need for methodological refinement of stated preference elicitation. Hensher (2010) summarizes the current state of the methodological discussion and provides guidance for future research. Miller et al. (2011) show that even if elicitation methods generate hypothetical bias, WTP estimates may still lead to the right demand curves and thus provide information relevant for pricing and policy.

Bearing in mind these challenges and the specific market situation of this study, discrete choice experiments proved to be a simple and resource-efficient method, even when respondents were illiterate and needed to memorize the attributes of choice options. Therefore, and taking into account the methodological discussion, we propose that the orientation of measured utility is valid and commend discrete choice experiments as a powerful tool; however, discussing the magnitude of utility, particularly regarding WTP and the hypothetical attribute "organic certification", will be a challenging field for further study.

Another major challenge in applying the discrete choice experiments was to communicate the idea of choosing based on quality to respondents who were mostly used to choosing based on quantity. This was particularly so for options which differed in price but not in obvious outer appearance. In that case, respondents tended to choose the more expensive option, implying that a higher price indicates that the product is "better" in some way for example a sauce perceived to contain more meat due to its higher price (consumer experiment). Although the researchers underlined that this was not the case, some respondents insisted on this perception. For the consumer experiment, this can be explained by the common principle of adding ingredients to meals depending on the available budget. Generally, this perception is suggested to be the main reason for the relatively low negativity of the price coefficient, which had high standard deviations in both vendor and consumer experiment. A possible solution to this challenge would be the use of a labeled choice experiment, including additional information such as vending spot location and meat content. This, however, may complicate the choice experiment considerably, which makes its application in these specific markets unrealistic.

In sum, discrete choice experiments are useful for exploring marketing potentials, with a number of weaknesses that primarily concern the preparation of the experiment and its application in the field. We therefore recommend placing strong emphasis on these phases of market research, particularly when the market is not well characterized beforehand. Furthermore, we propose to complement future studies with a distinct qualitative element, despite the inclination of policy makers and academia towards numbers and figures. Such a qualitative element would help to validate results, particularly in markets where beliefs and attitudes underlying choice behavior are not well understood.

Conclusion

Considering chemical contamination of vegetables in urban West Africa, as well as urbanization trends and a shift in dietary habits towards eating outside the home, the objectives of this research were: (1) to understand the use of vegetables and related risk perceptions in the food vending sector; (2) to investigate food vendor and consumer preferences regarding fresh and prepared vegetables; (3) to explore the potential for marketing certified organic vegetables in the food vending sector.

The vegetables used included mainly tomato, cabbage and onion. Tomato was considered risk prone in general, while the risk perception of cabbage consumption was associated with awareness of chemical contamination, in contrast to lettuce which was associated with awareness of biological contamination.

The appearance of a vegetable (including freshness and color) was central to vendor choice, while consumers awarded a similar utility to taste and hypothetical organic certification. The WTP for organic certification was on average 0.848 USD for a 3 kg basket of fresh tomatoes (vendors) and 1.044 USD per plate (consumers).

Based on the findings of this research, we suggest focusing intervention on facilitating safer production practices of tomatoes, cabbage and lettuce; more information on volumes consumed and on actual exposure risk will be important for accurate risk assessment. A strong effort to raise awareness regarding risks related to vegetable consumption and regarding the benefits of organic production and marketing will be equally important.

If certified organic vegetable production is to make a positive impact on food safety in urban West Africa, we suggest concentrating marketing efforts on an educated "elite," focusing on the symbolic value of eating healthy foods. However, considering that restaurateurs exhibited lower preference for organic certification than lower class food vendors, the marketing situation is difficult. We therefore conclude that demand from the food vending sector alone is unlikely to turn the vegetable production and marketing system towards safer and more sustainable strategies, such as certified organic production and marketing. This underlines the importance of strong public commitment to a multi-stakeholder process for developing domestic certification mechanisms.

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